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AD HOC 144-III SPACE COORDINATION

THIRD INTERIM REPORT

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November 12, 1976

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PREFACE

This document, GRC-706-III, dated November 12, 1976 is the third interim report for the Space Coordination Task of Ad Hoc 144-III. It updates the second report, GRC-548-III, dated June 30, 1976. This report should be considered as superceding the earlier reports.

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1. INTRODUCTION

This is the third interim report on the space coordination task. It deals primarily with the currently available space related CCIR documents as they relate to proposed allocations and the effect they may have on the Radio Regulations. Areas requiring additional technical support are identified and, in some cases, approaches in treating recommendations in the documents are suggested.

All space-related output documents from the 1976 Study Group Interim Meetings, as well as any documents from the XIIIth Plenary (Volumes I - XI) which were not revised, were reviewed. (The Block A Study Group papers from the February-March Meetings were reviewed from those published by CCIR while the Block B Study Group papers from the May-June Meetings were reviewed from hand-corrected copies of the output documents.)

The remainder of this report has the following Sections and Appendices:

Section 2 provides a summary analysis of the CCIR documents and points out some of the more important areas that need further attention.

Section 3 provides a detailed analysis of the documents as they relate to the Radio Regulations and includes

comments on matters that need further technical support.

Section 4 lists those Regulations, other than Article 5, which would appear to be affected by the documents.

Section 5 presents some conclusions about the status of technical support in preparing for the 1979 GWARC from a CCIR viewpoint.

Appendix A contains a matrix, showing each paper and the Regulation(s) to which it relates or which it affects.

Appendix B contains abstracts of all the papers which relate to or have an effect, direct or indirect, on the Regulations. An assessment of the impact of each paper on specific Regulations is also included.

Appendix C is a listing of all other space-related Reports, Questions, and Study Programs.

Appendix D contains copies of correspondence relating to sharing and related studies for the bands above 10 GHz.

2. SUMMARY ANALYSIS

This section presents a summary review and analysis of the currently available CCIR documentation as it relates to proposed new allocations, insofar as they are known, and to the possible effects of the documents on the Radio Regulations. Space related services are discussed first and then those Articles of the Regulations which could be affected by the CCIR documentation.

A more detailed analysis is provided in Section 3.

Broadcasting-Satellite Service

Most of the new CCIR documents are concerned with the 12 GHz band, in preparation for the 1977 WARC. Preparation activities are separate for that conference and are not covered here.

There are conflicting values of PFD limits required to protect terrestrial broadcasting in the 620-790 MHz band. The values range at least 5 dB on each side of the provisional value given in Footnote 332A. It should be determined whether further effort is desirable to clarify the protection criteria. These values could be a factor in considerations if the proposed mobile-satellite sharing in this band is accepted.

The FCC proposed allocations table adds fixed and mobile to share with the presently exclusive 40 and 80 GHz Broadcast Satellite bands. Sharing studies may be required.

Earth Exploration-Satellite Service

Reports support the proposed allocations for wide-band data around 15 GHz, with a narrow-band segment having a high PFD limit to provide limited data to small low-cost earth stations. There is no sharing report supporting this proposed allocation.

A report proposes incorporating active space sensors in the radiolocation bands. Additional reports are required to complete the technical support requirement, particularly sharing.

Information on passive sensors is provided in reports, but additional sharing reports are required to fully support proposed allocations.

Fixed-Satellite Service

There are documents which support the band allocations up to about 30 GHz, and sharing with terrestrial fixed service and broadcast satellites. There are no papers which discuss sharing with mobile-satellites.

Allocations above 30 GHz, made by the 1971 WARC, have no substantial documentation. Whether or not such documentation is needed would depend on the competition for these frequencies.

Reports indicate that short hop inter-satellite links located in the terrestrial fixed service bands of 3 to 7 GHz are feasible and desirable, but no allocations have been proposed.

There is a report which concludes that bi-directional fixed-satellite bands are difficult to share with the Fixed Service, but could be feasible, and possibly desirable, in exclusive fixed-satellite bands. No proposals have been made.

There is a proposed revision to the existing recommendation, to tighten the stationkeeping tolerance. Several reports discuss polarization, antenna beam shaping, and modulation techniques as a means of improving sharing, but the reports provide insufficient information for incorporation into the Radio Regulations.

Meteorological-Satellite Service

Reports state a future requirement of 300 MHz for wide-band data in Band 10. No allocation proposal has been made.

Comments on active and passive sensors for this service are similar to those made for EES.

Mobile-Satellite Service

There are a number of documents dealing with the use of the bands presently allocated at 1.5-1.6 GHz, but a general lack of reports dealing with frequencies higher than this. Report 504-1 concludes that 10 to 20 GHz is the upper limit for aeronautical and maritime satellites. Thus, there is no support for existing or proposed allocations in the higher frequency bands.

Existing reports deal primarily with sharing between and among aeronautical and maritime satellite and companion terrestrial services. At present, there are no documents which support proposed sharing of allocations with other space and terrestrial services except for radio determination. Papers discussing sharing with fixed-satellite and with terrestrial fixed, mobile and broadcasting would appear to be in order. The use of antennas with $D/\lambda < 100$ could also be a consideration.

There are no documents which discuss the land mobile-satellite service. This service has been listed in the tentative FCC allocation table.

Radio Astronomy

Reports support additional protection for certain line frequencies. In many cases, the tentative allocation proposals support this.

An exclusive allocation below 10 MHz is recommended, but no allocation proposal has been made.

A revised report supports comprehensive coordination requirements with radio astronomy by other space services operating farther than 100,000 km from the earth. These requirements should be reviewed to determine what exceptions should be taken to the report.

Space Research Service

Near Earth Space Research

There is a report supporting TDRS type activity, but there are no sharing reports covering the 13-15 GHz band.

A report establishes the basis for higher PFD limits for near earth orbiting satellites. It does not provide sufficient information to determine changes to the Radio Regulations.

Comments for active and passive space research sensors are similar to those under EES.

Deep Space Research

Reports state the requirements for a paired band for deep space research above 10 GHz, and tighter protection criteria for earth stations. There are no papers supporting sharing with fixed, mobile and radiolocation, as proposed in the allocations for the paired band above 10 GHz.

Reports indicate the desirability of excluding other space services and, on a local basis, aeronautical mobile from bands used for deep space (space-to-earth).

Article 1

Further technical documentation is required to support the incorporation of active space sensors in the definition of radiolocation service.

A new Recommendation provides definitions for interference. The definition for harmful interference is different than the one now in the Regulations. The FAA has stated a preference for the one in the Regulations.

Article 2

A new method of classification of emissions is presented which is different from that in the Regulations and the one in Opinion 44 of Study Group 1. It would appear to overcome many of the objections of a number of administrations to Opinion 44, which was felt to be too detailed for the purposes of international notification.

Article 7

Ad Hoc 144-III has asked the TSC to review the PFD limits in the Radio Regulations (GRC-442-III) as they relate to space and terrestrial services other than fixed-satellite sharing with fixed and mobile services. There are some CCIR papers that address this question for certain aspects, but there are none, at present, that treat other space and terrestrial services in sufficient depth to support new PFD limits and other sharing constraints for the Regulations.

Information should become available, if the sharing studies which have been suggested as a result of proposed allocations in 144-Id are carried out, which would allow establishment of PFD limits and other sharing constraints for a number of these services. Some of the areas concerned are: mobile-satellite sharing with fixed-satellite, and also with terrestrial fixed, active space sensors with radio-location, and near earth satellites sharing with a number of services. Similar sharing studies and possible CCIR papers should be considered for appropriate areas below 10 GHz also.

It is recommended that the TSC be kept abreast of the results as they become available, and that the TSC review results for possible application to areas not covered by the studies, and for possible common or combined approaches to Article 7 to be taken at the 1979 GWARC.

Appendix 28

Somewhat simpler procedures are proposed for Appendix 28, along with extension of the reference antenna pattern to the space research service. Both appear desirable. Information is presented which would indicate that the reference antenna pattern could be extended to D/λ less than 100.

Appendix 29

There is a consensus that Appendix 29 should be improved so as to be applicable to other than the fixed-satellite service. (Report 453-1 (Rev. 76) provides some information which could help accomplish this for the fixed-satellite service). Additional information was presented at the recent OTP symposium which, if incorporated in the CCIR documentation, could be used to provide a basis for improved procedures applicable to other services.

Article 12 and Appendix 4

There are a number of CCIR documents that deal with spurious emissions and adjacent band interference. Recommendation 329-2 of Study Group 1 extends limits of spurious emissions from 235 to 960 MHz. Recommendation AB/2 treats adjacent band interference at radio astronomu. Other CCIR documentation covers certain bands and services above 960 MHz, but they are relatively few.

Consideration should be given as to whether it is desirable or necessary to develop limits of spurious emissions at frequencies higher than 960 MHz. Also, in line with the discussions at the recent OTP symposium on coordination, consideration should be given whether such values should be incorporated in the Radio Regulations or retained as CCIR Recommendations with referral to them by the Regulations.

General Comment

In a number of places in Section 3, reference is made to the desirability of incorporating by references specific technical criteria in CCIR Recommendations that have been accepted by a CCIR Plenary Assembly, rather than listing them in the Radio Regulations. In this way criteria could be kept more up to date than at present since CCIR Plenary Assemblies meet more often than WARC's.

The problem of having the latest technical criteria available for sharing and coordination activities in the ITU was recognized at the 1971 WARC-ST. As a result, Resolution No. Spa 2-6 was adopted, which provides a procedure for introducing into the ITU new criteria which have been accepted by a CCIR Plenary Assembly. However, use of the new criteria is at the option of each administration until such time as they are accepted by a WARC.

This Resolution could be used as a basis for an argument to make CCIR Recommendations on technical criteria binding once they have been accepted by a CCIR Plenary Assembly.

3. TABULATIONS AND ANALYSES

This section contains tabulations and their corresponding analyses for documents with a definite effect on the Radio Regulations.

Each document is analyzed, and its effect(s), if any, on the Radio Regulations is indicated. It is also listed on one of the matrices in Appendix A (according to Study Group). Those papers with a definite impact, whether direct or indirect, appear on tally sheets in this section under the particular regulation affected and are indicated on the matrix as solid circles. Documents that are merely related to a specific regulation(s), but have no effect, even indirectly, are indicated by open circles on the matrix. They are abstracted with the rest (see Appendix B), but do not appear in this section.

3.1 Description of Tabulations and Analysis

Tabulations

From left to right, the tally sheets contain the following information:

- Subsection - Specific paragraph or area of Radio Regulation affected.

- Document Number(s) - Post-interim numbers are used where available; however, some are still identified by the CCIR document numbers used at the Interim Meeting. These are enclosed in parenthesis and indicated by "IM CCIR" before the number. All documents contributing to a specific effect on the Radio Regulation are grouped together.
- Study Group - The study group which generated the document(s).
- Type - Identifies Revised or New Report, Recommendation or Opinion.
- Service - The abbreviation of the Radio Service for which the document was generated.
- Synopsis - A short description of the document(s) particularly in light of the effect(s) to the Radio Regulation.
- Effect - DIR for direct, and IND for Indirect.

A paper which is identified as "direct" provides the technical basis for existing regulations or for specific revision(s) to the Radio Regulations.

An "indirect paper" does not in itself portend the necessity for redrafting a Radio Regulation, but will influence interpretation of the Radio Regulations, and under the provisions of Resolution Spa 2-6, may serve as guidelines for interpreting and applying the Radio Regulations. For example, propagation reports, system descriptions (including communication techniques), and papers with tentative values of PFD's, spurious emissions, etc., are considered indirect.

Analyses

Finally, summary conclusions from the information tabulated are presented after each Radio Regulation tabulation. A comment follows each analysis which points out areas of insufficient support, and in some cases, potentially desirable courses of action.

Organization

The tabulations and analyses are organized numerically with articles first, and then appendices of the Radio Regulations. These are further subdivided, where necessary, into services which are arranged in alphabetical order.

3.2 Tabulations and Analyses

TABULATION OF PAPERS FOR RADIO REGULATION: ARTICLE 1, TERMS AND DEFINITIONS

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
Definitions	362-1 AF/2	2 2	Recommendation New Report	Met.-Satellite, Earth-Exploration Satellite	Papers consist of characteristics, but it is indicated that a definition is required for radiolocation space stations	DIR
IIB	548(Rcv 76)	2	Rev. Report	Space Research	Definitions provided for near earth space and low orbit of a satellite	DIR
	AA/10-11	10-11	New Rec.	Broadcasting-Satellite; Fixed-Satellite	Provides additional definitions for the Broadcasting-Satellite Service and Fixed-Satellite Service (quality of reception and levels of PFD's in BSS).	DIR
	IM CCIR 1/106	1	New Rec.	All	Provides definitions for types of interference.	DIR

Other papers considered: 204-3 (S.G. 4)

ANALYSIS

ARTICLE 1

TERMS AND DEFINITIONS

Technical CCIR documentation exists on frequency requirements and characteristics of EES active space sensors and meteorological satellite radar experiments operating in the Radiolocation Service bands. A definition is needed to recognize the use of active space sensors in the Radiolocation Service.

Definitions for near earth space and the low orbit of a satellite are provided.

Certain CCIR documentation, if accepted, will add definitions on technical characteristics (such as reception quality) for the Broadcast-Satellite Service and the Fixed-Satellite Service.

Qualitative definitions are proposed for interference, and levels of interference (permissible and harmful), to be used in ITU texts. The definition of harmful interference is somewhat different than that presently in the Radio Regulations.

Comment:

Further technical documentation is required to support the proposed incorporation of active space sensors as part of the Radiolocation Service.

The FAA prefers the definition of harmful interference presently in the Regulations because it specifically mentions the Radionavigation Service.

Certain definitions, such as near earth space, low orbit and technical characteristics of broadcast satellites, would appear to be better retained in the CCIR documentation rather than incorporated in the Radio Regulations. Although important for CCIR purposes, many of the definitions deal with a level of detail not required for the Radio Regulations.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 2, DESIGNATION OF EMISSIONS

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	(IM CCIR 1/105)	1	New Recom- mendation	All Ser- vices	A new method of classifica- tion of emissions to replace Article 2	DIR

ANALYSIS

ARTICLE 2

DESIGNATION OF EMISSIONS

A method of classification of emissions is recommended to replace both the existing method in Article 2 and a differently organized version in Opinion 44 of Study Group 1 (Doc. 1/105). Relative to Article 2, the new method provides greater versatility in the classification of emissions for stations via a greater and more specific range of classification options and in addition, includes recent advances in modulation techniques.

For example, the alternative designations for types of main carrier modulation in the existing Article 2 are simply amplitude, frequency (or phase), and pulse. The new method expands the alternative designations to include unmodulated carrier, amplitude-modulation with various different types of sideband and degrees of carrier utilization and the various modulation alternatives of pulse emissions (i.e., in amplitude, duration, or phase, etc.).

The new method allows for a more general classification procedure than Opinion 44. However, administrations have the option of using two additional symbols to provide more detailed information if desired.

Comment:

This Recommendation would appear to overcome many of the objections of a number of administrations to Opinion 44 that the originally proposed procedures are too detailed for the purposes of international notification. A U. S. position should be developed on Document 1/105.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 5, SERVICE: EARTH EXPLORATION SATELLITE

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	AE/2	2	New Report	Earth Explor-	Supports allocation of about	DIR
	535(Rev 76)	2	Rev. Report	ation-Satellite	800 MHz bandwidth in vicinity of 15 GHz	
	AF/2	2	New Report	Earth Explor-	Bands which may be used by	DIR
	535(Rev 76)	2	Rev. Report	ation-Satellite	active and passive sensors	

ANALYSIS

ARTICLE 5

SERVICE: EARTH EXPLORATION SATELLITE

Technical documentation supports an allocation of 800 MHz bandwidth in the vicinity of 15 GHz for wideband data transmission. Tentative U. S. government proposals (Ad Hoc 144-Id) include Earth Exploration Satellites (space-to-Earth) in the non-government frequencies 17.9-18.7 GHz.

The frequency requirements of the active and passive sensors described in AF/2 are generally accommodated in the proposed government bands (Ad Hoc 144-Id).

Comment:

Sharing reports are needed to support the proposed allocation in the 17-19 GHz band for wide band data transmission; and in a number of bands for active and passive sensors.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 5, SERVICE: FIXED SATELLITE

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	557	4	Report	Fixed-Satellite	Possible conversion of fixed satellite bands to bi-directional	IND
	205-3 552 (Rev 76)	4 4	Report Report	Fixed-Satellite	Factors affecting the selection of frequencies for telecommunications with space stations	IND
	554 (Rev 76)	4	Rev. Report	Fixed-Satellite	Transportable earth station using 4/6 GHz fixed-satellite band for disaster relief operations	DIR

ANALYSIS

ARTICLE 5

SERVICE: FIXED SATELLITE

CCIR Report 557 considers bidirectional use of fixed satellite bands exclusively allocated to space radiocommunications services (i.e., no sharing with terrestrial). Further study is required.

Report 554 (Rev 76) presents characteristics of a transportable earth station which would operate with Intelsat type of satellites in the 4-6 GHz bands to support disaster relief operations. This is in response to Recommendation Spa 2-13.

Comment:

Allocation proposals appear to be supported by CCIR reports up to about 30 GHz. Allocations above this frequency, made by WARC 1971, have no substantial documentation in Study Group 4 or TSC. Whether or not such documentation is needed depends on what competition for these frequencies surfaces either in U. S. proposals or proposals from other administrations.

There are no Study Group 4 reports that treat allocations shared with the Mobile Service.

A footnote in Article 5 could note the use of the 4-6 GHz bands for disaster relief operations. (See Article 7 comments on coordination.)

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 5, SERVICE: RADIO ASTRONOMY

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	223-3(Rev 76)	2	Rev. Report	Radio	Allocations for radio astronomy line frequencies	DIR
	314-3(Rev 76)	2	Rev. Rec.	Astronomy		
	AI/2	2	New Report			
	224-3(Rev 76)	2	Rev. Report			
	479	2	Recommendation	Radio	Gives guidelines for determining specific bands which should be protected on the shielded side of the Moon	DIR
	539(Rev 76)	2	Rev. Report	Astronomy		
	336-1	5	Report			
	AK/2	2	New Report	Radio	Sharing problems may result from high power services adjacent to radio astronomy bands	IND
	226-3(Rev 76)	2	Rev. Report	Radar	Local or regional arrangements are suitable for radar astronomy	IND

ANALYSIS

ARTICLE 5

SERVICE: RADIO ASTRONOMY

Recommendation 314-3 (Rev 76) lists in a table the bands required for observations of natural line emissions. The U. S. government and non-government proposed allocations, thusfar announced, have accommodated all but two of the lines by new allocations or by expanding the bandwidth of existing allocations. Bands required to detect excited hydrogen (36.4-36.5 GHz) and Formaldehyde (14.485-14.495 GHz) are not included in the proposed allocations. The Recommendation also states a requirement for a band below 10 MHz. This has not been provided in the proposed allocation tables.

Report 539 (Rev 76) provides guidelines regarding the protection of the shielded side of the Moon for the use of passive observations. The proposed revision consists of changing the limits on the view site, which determines the shielded zone of the Moon from the Earth's surface out to the 100,000 km radius point. The net effect is to reduce the volume of the shielded zone of the Moon from a cone with a perpendicular bisector length of approximately 60,000 km to a cone which extends only about 3300 km out. In addition, the proposed revision removes the table of frequencies to be protected and coordinated with by spacecraft outside the 100,000 km radius orbit, and replaces it with text to the effect that all frequencies are to be free for passive use, with a few active exceptions such as deep space probes.

According to Report AK/2, it is best not to allocate services with satellite transmissions or high-powered terrestrial transmitters adjacent to radio astronomy bands, or spectrum-costly guard bands may be required.

Report 226-3 (Rev 76) indicates that local arrangements are adequate for radar astronomy and that allocations need not be considered.

Comment:

Reports, in general, cover the proposed allocations.

It will be desirable to develop an alternative to Report 539 (Rev 76) which provides a list of frequencies to be protected on the shielded side of the Moon, along with a U. S. position in opposition to the current report. (See comment under Article 7.) This should be a matter of priority for the Final Meeting of the CCIR.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 5, Service: Space Research

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	537	2	Report	Space Research (near earth)	Support for future possible allocations to provide for TDRS frequency requirements	IND
	AJ/2	2	New Report	Space Research (deep)	Supports revision of allocation at 2290-2300 MHz to space research (deep space only)	DIR
	365-2 (Rev 76) AN/2 AL/2 536 (Rev 76)	2 2 2 2	Rev. Rec. New Report New Report Rev Report	Space Research (deep)	Recommends paired allocations at 2, 8, and above 15 GHz	DIR
	364-2 (Rev 76) 548 (Rev 76)	2 2	Rev. Rec. Rev. Report	Space Research (near earth)	Supports existing allocations and raises usable frequencies to 30 GHz	DIR
	367	2	Recommendation	Space Research	No impact to Article 5, can use space research allocations already there (re-entry communications)	IND
	456-1 (Rev 76)	2	Rev. Report	Space Research	Supports new allocations above 10 GHz for beacons (specific band areas mentioned)	DIR

ANALYSIS

ARTICLE 5

SERVICE: SPACE RESEARCH

Frequency-independent sharing considerations for the TDRS system are described in existing CCIR technical documentation. TDRS requirements occur within the 13.25 to 15.35 GHz frequency range. An existing Footnote 407A permits Earth-to-space space research transmissions on a secondary basis. U. S. government proposed allocations include primary allocations for space research (Earth-to-space) at 14.0-14.3 GHz and at 14.4-14.5 GHz. Further research is presently underway for the 14.5-15.35 GHz band, including study of the technical feasibility of sharing with fixed and mobile services.

CCIR technical documentation indicates that sharing is infeasible between the deep space network and a near earth spacecraft of a selected orbit. No general studies have been made yet; however, indications are that the 2290-2300 MHz space research (space-to-Earth) allocation should be revised following further study, to deep space only.

Frequency requirements for deep space include frequencies around 2 GHz and 8 GHz, above 15 GHz, and one below 25 MHz for re-entry and recovery. The U. S. government proposed frequencies include a primary allocation for space research (Earth-to-space) at 16.6-17.1 GHz and 12.75-13.25 GHz (space-to-Earth).

Satellite beacon requirements include a need for a frequency harmonically related to 20 MHz, located in the range of 80 to 200 MHz. A secondary allocation exists around 140 MHz. Other frequency requirements occur at 15, 20, 30, 90 and 150 GHz. In general, proposed allocations do not accommodate beacon requirements above 400 MHz.

Comment:

Additional sharing and PFD reports are needed to support proposed space research allocations in the 13-15 GHz bands and the proposed allocations at 12 and 16 GHz for deep space. In addition, examination of PFD limits in the S-band area is required.

Little, if any, additional work appears to be required for beacons.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 5, SERVICES: ALL OTHERS

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	362-1	2	Recommendation	Meteorological Satellite	Supports existing allocations. Requirement of 300 MHz wide-band telemetry in Band 10	DIR
	395-2 (Rev 76)	2	Rev. Report			
	216-2	8	Report	Radionavigation Satellite	Description of terrestrial radio determination and the use of satellites. Info. only.	IND
	565 (Rev 76)	2	Rev. Report	Broadcasting-Satellite	Attenuation data for planning of broadcasting satellite systems at 12 GHz	IND
	591 (Rev 76)	8	Rev. Report	Mobile Satellite	Supports existing allocation	DIR
	504-1	8	Report			
	593	8	Report			
	511	8	Report			
	451-1 (Rev 76)	4	Rev. Report	Inter-satellite	Supports allocations for short-hop inter-satellite service in lower part of Band 10 shared with the fixed service	IND
	387-2 (Rev 76)	4	Rev. Report			
	564 (Rev 76)	5	Rev. Report	All space services	Information on propagation for space telecommunications	IND
	234-3 (Rev 76)	5	Rev. Report			
	426-1 (Rev 76)	5	Rev. Report			

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 5, SERVICES: ALL OTHERS

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	361-2	8	Recommendation	Radiodetermination	Supports existing allocations	DIR
	394-1	8	Report			
	513-1	8	Report			
	595 (Rev 76)	8	Rev. Report			
NEW	363-1	2	Recommendation	Space Operations	Include TTC with data transmission or communications in the operational satellite bands	DIR
	396-2	2	Report			

Other Documents Considered: 540 (S.G. 2)
263-3 (Rev 76) (S.G. 6)
592 (Rev 76) (S.G. 8)

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ANALYSIS

ARTICLE 5

SERVICES: ALL OTHERS

Meteorological-Satellite

Report 395-2 (Rev 76) indicates a requirement of 300 MHz for wideband telemetry in Band 10. Recommendation 362-1 was not modified to take note of this requirement, nor has an allocation been proposed.

Inter-Satellite

Technical arguments are presented for the use of short-hop inter-satellite links and an allocation proposal may be in order in the lower part of Band 10 shared with the Fixed Service. No allocations have been proposed.

Space Operations

The CCIR recommends and technically supports, where feasible, that operational satellite bands (such as those for meteorological, radionavigation and communications purposes) used for data transmission or communications also include telemetering, tracking and telecommand.

Mobile-Satellite

Present reports support existing allocations. Little information is provided on use of mobile-satellites above 2 GHz and Report 504-1 indicates useful upper limits at 10 to 20 GHz. The land mobile-satellite service is not addressed; but is included in the FCC's table of proposed allocations.

Comment:

Documentation is needed for the proposed mobile-satellite allocations, both in the higher frequency bands and in sharing with other services such as the fixed-satellite.

The other services listed above seem to be adequately covered by reports although, as noted above, some are not supported by proposed allocations.

TABULATION OF PAPERS FOR RADIO REGULATION: ARTICLE 7, SERVICE: BROADCAST SATELLITE

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
VII & VIII	631 (Rev 76)	11	Rev. Report	Broadcasting-Satellite	If adopted, modify Article 7/VIII (PFD, power limits, choice of sites) (Bands: 600 MHz, 2500 MHz & 11.7 GHz)	IND
Section IA, VII, & VIII	AE/10-11	10/11	New Report	Fixed Satellite; Broadcasting-Satellite	Description of several approaches to sharing at 11.7-12.2 GHz	IND
VIII	AG/10-11	10/11	New Report	Broadcasting-Satellite	PFD values given at 12 GHz but do not assess effects on shared services	IND
VIII 470 NS Spa 2	(IM CCIR 9/125)	9	New Report	Fixed; Broadcasting-Satellite	Provides PFD values for broadcasting-satellite service at 11.7-12.5 GHz to permit sharing with fixed service.	IND

ANALYSIS

ARTICLE 7

SERVICE: BROADCASTING-SATELLITE

SECTION VIII

CCIR Reports AG/10-11, AE/10-11 and 631 (Rev 76) discuss PFD limits and requirements for broadcast satellites and analyze sharing with other services. Three bands are covered:

a. 620-790 MHz

Provisional PFD limits are given in Recommendation Spa 2-10 for protecting the terrestrial broadcasting service. Information presented by France, UK and EBU suggest the values should be 9 dB lower, while information from the U. S. and USSR suggest the values could be 5 to 6 dB higher than those in Recommendation Spa 2-10. The CCIR does not take a position on the value to be used, preferring to wait for additional information.

A similar position is taken on sharing with fixed and mobile, although data shown for land mobile would indicate that sharing at about 800 MHz would be questionable.

b. 2500-2690 MHz

Data presented indicates that somewhat higher limits than in the Regulations can be used when sharing with the ITFS. Co-channel sharing with line-of-sight radio relay is very difficult for the broadcasting-satellite because of the relatively inflexible requirements of frequency selection for the LOS system.

This, among other things, would explain the general lack of interest in Region 1 for broadcast-satellites in this band, since Europe makes heavy use of LOS systems.

c. 11.7-12.2 GHz (11.7-12.5 GHz, Region 1)

Report AG/10-11 specifies PFD requirements that are 8 to 10 dB higher than the PFD limits given for the bands on either side of this band (no PFD limits are given for 11.7-12.5 GHz). Study Group 9 Document 9/125 indicates a maximum permissible PFD TV radio-relay AM/VSB of -134 dBW/m^2 for low angles. Report 631 (Rev 76) generally concludes that sharing between broadcasting-satellites and terrestrial broadcasting and fixed services is

better done by frequency division of the band while Report AE/10-11 concludes that orbit division is the most suitable sharing approach for fixed-satellites and broadcast-satellites.

While these conclusions are most pertinent for the 1977 WARC on broadcast-satellites, they could also affect the 1979 GWARC. The CCIR papers generally lend support to the a priori planning approach being fostered by the Europeans for the band, when the band is allocated as it is in Region 1.

Comment:

Activities in preparing for the 1977 WARC would appear to cover most requirements for this service. There are two possible exceptions: One is whether it is desirable to further clarify the protection criteria in the 620-790 MHz band. The second is possible sharing studies in the 41-43 and 84-86 GHz bands which were allocated exclusively to broadcast-satellites by the 1971 WARC, but are now shown as sharing with fixed and mobile in the FCC proposed table of allocations.

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TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 7, EARTH EXPLORATION SATELLITE SERVICE

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
VIII, 47ONX, NY, NZ	AE/2	2	New Report	Earth Explor- ation Satel- lite	Revise 47ONX, NY & NZ to allow higher PFD's for the low cost terminals at 17.90-17.95 GHz	DIR
	540	2	Report	Earth Explor- ation-Satel- lite	Supports sharing in the 8 GHz band	

ANALYSIS

ARTICLE 7

SERVICE: EARTH EXPLORATION SATELLITE SERVICE

Section VIII

CCIR Reports show that Article 7 PFD limits are too low to meet the requirements for this service, especially for the low cost terminals which must use small receiving antennas. Bandwidth requirements for low cost terminals are stated to be greater than 20 MHz.

Comment:

Requirement is met in the tentative 144-Id allocation table by proposed Footnote 409CA which provides unlimited PFD at 17.90-17.95 GHz. Additional technical support would appear to be required to support this proposal.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 7, SERVICE: FIXED SATELLITE

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
VIII	451-1(Rev 76) 387-2(Rev 76)	4	Rev. Report	Fixed-Satellite	Short hops inter-satellite links can share with fixed service (see also 387-2(Rev 76))	IND
VIII	358-2	4,9	Recommendation	Fixed-Satellite	Establishes PFD limits for bands shared between space and fixed/mobile	DIR
VIII	387-2(Rev 76)	4,9	Rev. Report	Fixed, Fixed-Satellite	Provides maximum permissible PFD's from space stations in the fixed-satellite service in order to protect radio relay stations in the fixed service in the shared bands between 1 and 23 GHz	DIR
IX	555(Rev 76)	4	Rev. Report	Fixed-Satellite	Polarization for increasing utilization of orbit	IND
IX	558(Rev 76)	4	Rev. Report	Fixed-Satellite	Added regulations regarding geostationary satellite-to-satellite sharing	IND
IX	484(Rev 76) 556(Rev 76)	4 4	Rev. Rec. Rev. Report	Fixed-Satellite	Revise Radio Regulation 470VC + 1° to + 0.5° of longitude	DIR
IX	559 453-1(Rev 76)	4 4	Report Rev. Report	Fixed-Satellite	Same changes with respect to approaches to increased use of fixed satellites, could add paragraphs to Section IX	IND

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 7, SERVICE: FIXED SATELLITE

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
IX	561 (Rev 76)	4	Rev. Report	Fixed-Satellite; Broadcast-Satellite	Describe methods of sharing between fixed-satellite and broadcast-satellite at about 12 GHz	IND
IX	496	8	Recommendation	Fixed-Satellite;	Provides protection criteria for fixed-satellites at 14.0-14.4 GHz	DIR
	560	4	Report	Radionavigation; & Radionavigation-Satellite		
IX	557	4	Report	Fixed-Satellite	Use of bi-directional bands in exclusive fixed-satellite bands is feasible; difficult with fixed	IND
IX	554 (Rev 76)	4	Rev. Report	Fixed-Satellite	Transportable station in 4/6 GHz band for disaster relief operations. Not feasible to use existing coordination procedures.	DIR

Other papers considered: (IM CCIR 9/132)

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ANALYSIS

ARTICLE 7

SERVICE: FIXED-SATELLITE

Section VII

Report 554 (Rev 76) is in response to Recommendation Spa 2-13, which recommends that Administrations plan their space radiocommunications for relief operations, and waive coordination procedures in the case of transportable earth stations used for relief operations. The CCIR is invited to study standard specifications, preferred frequencies and compatible equipment for this purpose.

The systems described in Report 554 (Rev 76) use the 4 and 6 GHz band and contemplate using Intelsat IV global beam type transponders. Waiver of coordination procedures would be required if this system were to be successfully used for emergency purposes.

SECTION VIII (Inter-Satellite)

Reports 451-1 (Rev 76) and 387-2 (Rev 76) discuss inter-satellite links to support the fixed-satellite service. For short-hop links, frequencies in the 3-7 GHz region are shown to be suitable, provided they are not in the fixed-satellite up or down-link bands. The Reports show that using the terrestrial fixed service bands will cause PFD's on the Earth's surface well below the limits presently in the Radio Regulations.

SECTION VIII (PFD Limits)

Recommendation 358-2 provides much of the basic data used to establish the PFD limits in Article 7. Not all bands are covered in either the Recommendation or the Regulations. Both primarily are concerned with establishing PFD limits to protect the terrestrial fixed or mobile services. This matter has been referred to the TSC for consideration (see GRC-442-III and GRC-344-III).

SECTION IX

Reports 555 (Rev 76) and 558 (Rev 76) provide information on using polarization and improving antenna patterns for increasing utilization of the geostationary orbit. While the information is useful in design approaches to improve use of the orbit, not enough information is available to modify the Radio Regulations. Based upon comments at the recent OTP symposium, polarization techniques may be best reserved for use within a satellite network rather than between networks.

SECTION IX

Reports 559 and 453-1 (Rev 76) provide technical criteria from which a considerably more efficient use of the geostationary orbit can be made. Subjects covered include antenna pattern improvement, preferred polarization, spot beam pointing accuracy, modulation characteristics, etc. These Reports will lead to revised Recommendations as an adequate technical basis is established. The only revised Recommendation identified at this time is Recommendation 484 which reduces the tolerance of stationkeeping from $\pm 1.0^\circ$ to $\pm 0.5^\circ$.

SECTION IX

Report 561 (Rev 76) concludes that it is technically possible, on a shared basis, to use the bands 10.95-11.2 GHz and 12.5-12.75 GHz for the up-path connections for broadcast-satellites and the down-paths for the fixed-satellites, however, no CCIR Recommendation exists. If such allocations are made, sharing criteria relating to orbit spacing, antenna gains and earth station distances would have to be provided in the Radio Regulations. The Report has information which, if acceptable, could be used for such revisions.

SECTION IX

Recommendation 496 specifies PFD's at geostationary altitude to protect fixed-satellite space station receivers from transmissions of the radionavigation and radionavigation-satellite services in the 14.0-14.4 GHz band. The values were accepted provisionally at the XIIIth Plenary of CCIR, with the recommendation that they be further studied before the XIVth Plenary. Neither the Recommendation nor the supporting Study Group 4 Report 557 was revised during the recent Interim Meetings of the Study Groups.

SECTION IX

Report 557 considers the use of bi-directional bands in the Fixed-Satellite Service. The Report concludes that considerable difficulties may be encountered in bands shared with terrestrial services, but that bi-directional use may be of particular value in conserving the spectrum where bands are allocated exclusively to space radiocommunication services. For this latter case, however, restrictions may have to be placed on power or antenna gains or both. Further study is recommended, but no activity at the Interim Meetings has been identified.

Comment:

A large amount of information is provided in the reports. Two Recommendations are made. One states PFD limits at geostationary satellite altitude from the radionavigation and radionavigation-satellite services in the 14.0-14.4 GHz band and the other provides tighter stationkeeping tolerances. The newly proposed stationkeeping tolerance of $\pm 0.5^\circ$ is probably not adequate operationally for the close satellite spacing required above 10 GHz, and is not up to the current state-of-the-art.

Other matters concerned with improving geostationary satellite utilization such as improved antenna patterns, polarization techniques, bi-directional use of bands and modulation techniques are indicated to require further study.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 7, SERVICE: RADIO ASTRONOMY

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
VII & VIII	314-3 (Rev 76) AI/2 224-3	2 2 2	Rev. Rec. New Report Rev. Report	Radio Astronomy	Recommends improved world-wide protection for 11 radio astronomy line frequency bands (1390 MHz - 115.5 GHz)	IND
IX	539 (Rev 76) 336-1	2 5	Rev. Report Report	Radio Astronomy	Revised for coordination with radio astronomy on shielded side of the Moon at distances further than 100,000 km from Earth	DIR

ANALYSIS

ARTICLE 7

SERVICE: RADIO ASTRONOMY

Line Frequency Protection

Recommendation 314-3 (Rev 76) calls for improved protection for the 11 radio astronomy line frequency bands in the 1390 MHz to 115.5 GHz region. Above 40 MHz the position is taken that frequencies can be shared with terrestrial services, provided care is given to shielding, and coordination is obtained for high power installations.

Shielded Side of the Moon

Report 539 (Rev 76) proposes that all active transmissions beyond 100,000 kilometers be coordinated with the radio astronomy service operating on the shielded side of the Moon. Technical support for choosing this distance is provided in Study Group 5, Report 336-1.

Comment:

If the U. S. should decide to accept the Report, a modified coordination procedure for the shielded side of the Moon would be to designate those bands to be protected on the shielded side of the Moon. Use of those bands, by services operating above 100,000 km would be the only ones coordinated through IFRB procedures.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 7, SERVICE: SPACE RESEARCH (NEAR EARTH)

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
VIII	AH/2	2	New Report	Space Research	Develops interference criteria (higher PFD's than geostationary) from low altitude satellites	IND
IX	364-2 (Rev 76)	2	Rev. Report	Space Research (near earth)	Establishes protection criteria not to exceed -171 dBW/kHz for .001% of the time at the spacecraft receiver for manned near Earth space stations	DIR
IX 470VF	546 (Rev 76)	2	Rev. Report	Space Research	Supports future changes to pointing accuracy	IND

ANALYSIS

ARTICLE 7

SERVICE: SPACE RESEARCH (NEAR EARTH)

SECTION VIII

New CCIR Report AH/2 establishes a partial basis for developing sharing models between low orbit spacecraft and terrestrial receivers. This could result in the development of higher PFD limits for low-orbit satellites than those presently listed which are based on geostationary satellites. Only EES has a presently stated requirement for this.

SECTION IX

Recommendation 364-2 (Rev 76) states the protection requirement of -171 dB(W/kHz) not to be exceeded for more than 5 minutes/day at the spacecraft receiver terminals for manned research missions, and -161 dB(W/kHz), not to be exceeded for more than 0.1% of the time. Neither are presently listed in the Radio Regulations.

SECTION IX

Report 546 (Rev 76) indicates that the pointing accuracy of geostationary satellites can technically be better than the 0.5° stated in 470VF.

Comment:

Additional technical documentation is required if a general increase in PFD limits for near earth satellites is desired.

Although protection requirements for spacecraft receivers are well documented, it would be difficult to write a practicable Radio Regulation.

No Recommendations have been proposed for more stringent pointing accuracies but Report AG/10-11 states that pointing error has a critical effect on planning in the 12 GHz broadcast-satellite band.

TABULATION OF PAPERS FOR RADIO REGULATIONS: ARTICLE 7, SERVICE: SPACE RESEARCH (DEEP)

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
VII, VIII, & IX	536 (Rev 76)	2	Rev. Report	Space Research (deep)	Technical information on the functional requirements of the U.S. deep space research telecommunication systems	IND
IX	365-2 (Rev 76)	2	Rev. Report	Space Research (deep)	Establishes protection cri- teria not to exceed -171 dBW/kHz for .001% of the time at the spacecraft receiver	DIR

ANALYSIS

ARTICLE 7

SERVICE: SPACE RESEARCH (DEEP SPACE)

SECTION IX

Recommendation 365-2 (Rev 76) states the protection requirement of -171 dB(W/kHz) not to exceed 5 minutes per day at the spacecraft receiver. This is not presently in the Radio Regulations.

Comment:

As in the near Earth case, it would be difficult to write a practicable Radio Regulation to meet the protection requirements of spacecraft receivers. In the deep space case, once the launch phase is over, operations generally are far enough from Earth that normal terrestrial transmissions would be below the harmful level.

TABULATION OF PAPERS FOR RADIO REGULATION: ARTICLE 12, TECHNICAL CHARACTERISTICS OF EQUIPMENT AND EMISSIONS

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICES</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	AE/2	2	New Rec.	Radio	Revised to cover filter re-	DIR
	AK/2	2	New Report	Astronomy	quirements and adjacent band frequency assignments	

ANALYSIS

ARTICLE 12

TECHNICAL CHARACTERISTICS OF EQUIPMENT AND EMISSIONS

RADIO ASTRONOMY

CCIR Recommendation AB/2 treats adjacent band interference to radio astronomy. A combined approach of filtering in the radio astronomy receiver and the adjacent band transmitter, and judicious assignment of frequencies in the adjacent band are recommended.

Comment:

A possible approach would be to incorporate the first two paragraphs in the "Recommends" section into Article 12. These are:

1. "that all practical, technical means, for example the use of filters, be adopted both in radio astronomy receivers and in adjacent band transmitters to the maximum practicable extent, in order to reduce interference to the Radio Astronomy Service;"
2. "that when frequencies are assigned to a station in a service operating in a band adjacent to one allocated on a primary basis to radio astronomy, attempts should be made to limit the edge of the necessary band adjacent to the radio astronomy band, so that the power radiated within this band should produce no harmful interference to a station of that service;"

In addition, reference could be made to appropriate CCIR documentation such as Recommendation AB/2 for administrations to consider when making assignments.

This would be in line with comments made at the recent OTP symposium: Principles stated in the Radio Regulations with referral to the latest technical information and/or guidelines in CCIR documentation.

TABULATION OF PAPERS FOR RADIO REGULATION: APPENDIX 4 (TOLERANCE LEVELS OF SPURIOUS EMISSIONS)

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
Table	AB/2	2	New Rec.	Radio Astronomy	Appendix 4 should be expanded to cover frequencies allocated to radio astronomy	DIR
Table	(IM CCIR 4/186)	4, 9	New Report	Fixed-Satellite; Broadcasting-Satellite	Tentative conclusions on spurious emissions indicates values above 235 MHz in radio astronomy bands required	IND
	AC/10-11	10/11	New Report	Broadcasting-Satellite	Provides data from which values of spurious emissions for the broadcasting-satellite service bands could be derived (12 GHz)	IND
Table	AF/4	4	New Report	Fixed-Satellite; Broadcasting-Satellite	Tentative values of spurious emissions (see AC/10-11) from 12 GHz broadcast satellites	IND
Table	(IM CCIR 9/125)	9	New Report	Fixed, Broadcasting-Satellite	Provides spurious emissions value for broadcasting-satellites at 11.7-12.5 GHz (also applicable to 12.5-12.75 GHz band)	DIR
Table	329-2	1	Rec.	All Services	Extends table to 960 MHz	DIR

ANALYSIS

APPENDIX 4

TOLERANCE LEVELS OF SPURIOUS EMISSIONS

Recommendation 329-2 presents spurious emission values for frequencies up to 960 MHz, and the table should include these.

Technical CCIR documentation and recommendations indicate the need to expand the table of spurious emission limits to cover frequencies higher than 235 MHz allocated to radio astronomy.

Tentative values of spurious emissions exist in the 12 GHz band to protect fixed-satellites from broadcast-satellites. Further study is required.

A spurious emissions value to protect the fixed service from the broadcast-satellite service in the 12 GHz band is provided.

Comment:

There was a general consensus at the recent OTP symposium that specific values and limits would, in most areas, be better contained in CCIR Recommendations with a notice in the Radio Regulations to refer to the Recommendations for values to be used.

Footnote 492B.1 in Article 9, dealing with interference criteria, could possibly be cited as a precedent if this approach is chosen.

Recommendation 329-2 from Study Group 1 extends values to 960 MHz. Some higher bands are covered by other Study Groups, but most are not.

TABULATION OF PAPERS FOR RADIO REGULATION: APPENDIX 28, COORDINATION PROCEDURE

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
Coordination Procedure	452-1 (Rev 76) 382-2 (Rev 76) AI/5 359-3	5 4 5 4,9	Rev. Rec. (to AF/5) Rev. Report New Report Rec.	Fixed-Satel- lite	New suggested procedure for replacing and simplifying parts of Appendix 28	DIR
Coordination Procedure (modes & figures)	563 (Rev 76) 233-3 (Rev 76) 369-1 (Rev 76) 426-1 (Rev 76) AC/5 AC/5 569	5 5 5 5 5 5 5	Rev. Report Rev. Report Rev. Rec. Rev. Report New Rec. New Report Rev. Report	Fixed-Satel. Fixed-Satel. Fixed-Satel. Fixed-Satel. Fixed-Satel. Fixed-Satel. Fixed-Satel.	Provides information on refraction, diffraction and propagation (technical background for propagation formulae and procedures)	IND
Table II	365-2 (Rev 76) AL/2	2 2	Rev. Rec. New Report	(Deep) Space Research	Lowers protection criteria for deep space, manned and unmanned to -222 dBW/Hz	DIR
Table II	364-2 (Rev 76)	2	Rev. Report	Space Research	Establishes protection for near earth manned (at .001%)	DIR
Tables 1-4	356-3 357-2	4,9 4,9	Rec. Rec.	Fixed-Satel. Fixed-Satel.	Support for interference values used in Tables 1-4 of App. 28	DIR
	388-2 (Rev 76)	4	Rev. Report	Fixed and Fixed-Satel- lite	Determination of interference taking into account modulation techniques	IND
Antenna Patterns	465-1	4	Rec.	Fixed-Satel- lite	Supports present radiation pattern in Appendix 28	DIR

TABULATION OF PAPERS FOR RADIO REGULATION: APPENDIX 28, COORDINATION PROCEDURE

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
3.2	391-2 (Rev 76)	4	Rev. Report	Fixed-Satellite	No impact but supports antenna pattern formula for $D/\lambda > 100$ and provides data for $D/\lambda < 100$	DIR
Antenna Patterns, 3.2	AA/2 AC/2	2 2	New Rec. New Report	Space Research	Antenna gain formula to include space research service as well as fixed-satellite	DIR
Antenna Patterns	AF/10-11	10/11	New Report	Broadcasting-Satellite	Reference antenna patterns for both satellite and ground receiving systems which could be incorporated into Appendix 28 (and 29)	IND
	355-2	4, 9	Rec.	Fixed-Satellite	Recommends that Recommendations 356-3, 357-2, 358-2, 359-2, and 406-3 be followed	IND
	554 (Rev 76)	4	Rev. Report	Fixed-Satellite	Transportable stations in 4/6 GHz band for disaster relief operations. Not feasible to use existing coordination procedures	IND

448-1 (S.G. 4, 9)
634 (Rev 76) (S.G. 11)

545 (S.G. 2)
241-2 (S.G. 5)
(IM CCIR 9/179)

386-2 (S.G. 4, 9)
(IM CCIR 4/191)
536 (Rev 76) (S.G. 2)

papers considered:

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ANALYSIS

APPENDIX 28

COORDINATION PROCEDURES

Existing technical documentation by the CCIR suggests a simpler procedure for the transmission loss and propagation sections of Appendix 28. Specifically, the new text eliminates mode (b) (concerning antennae pointed below 12° for long periods of time), substitutes different equations but similar figures for transmission loss, and uses the actual coastal boundaries as the zone boundaries rather than 100 km inland.

For Table II, CCIR reports indicate lower protection criteria for deep space, manned and unmanned, and establish protection for near earth, manned at .001%.

The present antenna pattern ($D/\lambda > 100$) is supported by the documentation, and data for developing a better radiation pattern for $D/\lambda < 100$ is provided (see Report AF/10-11). It is recommended and there is technical support for applying the antenna gain formula to the space research service, as well as fixed-satellite.

Reference antenna patterns for ground receiving systems in the broadcasting-satellite service are introduced for incorporation into Appendix 28.

Proposed transportable earth stations with small antennas for disaster relief operations could not conform to existing coordination procedures in such temporary and immediate circumstances.

Comment:

The somewhat simple procedures proposed for Appendix 28 appear desirable. Extending the reference antenna pattern to space research should be accomplished and consideration should be given to the establishment of a new reference pattern for antennas with $D/\lambda < 100$.

A provision in Article 7 could handle exemptions from coordination procedures for transportable earth stations used for disaster relief organizations. This would conform with the intentions of Recommendation Spa 2-13.

New concepts for coordination of mobile-satellite systems appear required.

TABULATION OF PAPERS FOR RADIO REGULATION: APPENDIX 29, CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
Procedure	454-1 (Rev 76)	4	Rev. Report	Fixed-Satellite	Technical support for the procedure in Appendix 29.	DIR
Procedure	555 (Rev 76)	4	Rev. Report	Fixed-Satellite	Add polarization considerations in calculating interference between geostationary satellites	IND
Procedure	(IM CCIR 4/151)	4	New Report	Fixed-Satellite	Information on the effects of adding polarization to the spacing of satellites in orbit	IND
Procedure	561 (Rev 76)	4	Rev. Report	Fixed-Satellite; Broadcasting Satellite	By use of polarization fixed satellite & broadcasting-satellite services can share (further support for Rep. 555 (Rev 76)	IND
Antenna Pattern	AF/10-11	10/11	New Report	Broadcasting-Satellite	Reference antenna patterns for transmitting satellite in broadcasting-satellite service for use in Appendix 29	IND
Antenna Pattern	558 (Rev 76)	4	Rev. Report	Fixed-Satellite	Provides tentative satellite antenna patterns for use in Appendix 29	IND
Annex	466-1 (Rev 76)	4	Recommendation	Fixed-Satellite	Increase in interference level value used in example in Annex of Appendix 29 is under study	IND

TABULATION OF PAPERS FOR RADIO REGULATION: APPENDIX 29, CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS

<u>SUBSECTION</u>	<u>DOC. NO.</u>	<u>STUDY GROUP</u>	<u>TYPE</u>	<u>SERVICE</u>	<u>SYNOPSIS</u>	<u>EFFECT</u>
	560	4	Report	Fixed-Satellite	Provides protection criteria for fixed-satellites at 14.0-14.4 GHz, however, coordination is preferred for 14.3-14.4 GHz	IND
	554 (Rev 76)	4	Rev. Report	Fixed-Satellite	Transportable station for disaster relief operations. Not feasible to use existing coordination procedures.	IND
	453-1 (Rev 76)	4	Rev. Report	Fixed-Satellite	Provides new information for determining interference between satellite networks (based on use of orthogonal polarization and frequency re-use)	IND

ANALYSIS

APPENDIX 29

CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS

Existing technical documentation provides information in areas such as antenna patterns, polarization techniques, up-links for broadcasting-satellites and allowable noise levels which could affect Appendix 29. The general conclusions, however, are that further work is required.

Comment:

Appendix 29 procedures as written, applies primarily to fixed-satellite systems which simply translate the input signal to a different frequency. These procedures are not easily applied to inhomogeneous systems. Existing CCIR documentation treats certain aspects of the problem but additional information is needed to significantly improve space coordination procedures.

Information presented at the recent OTP symposium, if incorporated into CCIR documentation, would appear to be a significant step in formulating a basis for improved coordination procedures in Appendix 29.

4. POSSIBLE MODIFICATIONS TO THE RADIO REGULATIONS

The purpose of this Section is to indicate those Radio Regulations, other than the allocations in Article 5, which are susceptible to modification as a result of the existing CCIR documentation. This is not intended to be a recommendation for modification of the Regulations but rather a listing of those changes which appear to be supported by CCIR Reports and Recommendations.

Article 1 Terms and Definitions

1. Modify existing definition of harmful interference (RR 93). Add new definition of permissible interference.
(S.G. 1, Recommendation 1/106)
2. Add definition to make radiolocation space stations part of the radiolocation service.
(S.G. 2, Report AF/2, Recommendation 362-1)
3. Add definition of near earth space.
(S.G. 2, Report 548 (Rev. 76))
4. Add definitions of reception quality and levels of power flux densities.
(S.G. 10/11B, Recommendation AA 10/11)

Article 2 Designation of Emissions

1. Replace Section I with a new and more detailed method of classifying emissions.
(S.G. 1, Recommendation 1/105)

Article 7

Section VIII

1. Revise 470 NX, NY and NZ to allow higher PFD's for small earth terminals in the EES at 17.90-17.95 GHz.
(S.G. 2, Reports 540 and AE/2)

Article 7 (cont)

Section IX

1. Revise 470 VC (stationkeeping) from $\pm 1.0^\circ$ to $\pm 0.5^\circ$ of longitude.
(S.G. 4, Recommendation 484 (Rev 76), Report 556 (Rev 76))
2. Add PFD limits at geostationary satellite orbit for radionavigation and radionavigation-satellite.
(S.G. 8, Recommendation 496, S.G. 4, Report 560)
3. Add paragraph exempting small earth terminals used for disaster relief operations from coordination procedures.
(S.G. 4, Report 554 (Rev 76))
4. Add paragraph covering coordination requirements for protected bands on shielded side of the Moon.
(S.G. 2, Report 539 (Rev 76))
5. Revise 470VF to state tighter pointing accuracy for geostationary satellites above 10 GHz.
(Note: No Recommendation has been made but S.G. 10/11 Report AG/10-11 implies requirement)

NOTE: Regulations to meet spacecraft protection criteria will not be proposed unless a suitable approach can be developed.
(S.G. 2, Recommendation 365-2 (Rev 76), Report 364-2 (Rev 76))

Article 12 Spurious Emissions

1. Add paragraphs on: (1) use of filters in radio astronomy receivers and adjacent band transmitters, (2) care in assignment of frequencies in bands adjacent to radio astronomy.
(S.G. 2, Recommendation AB/2, Report AK/2)

Appendix 4

1. Extend table above 235 MHz.
(S.G. 1, Recommendation 329-2, S.G. 4, Report AF/4, S.G. 10/11, AC/10-11, S.G. 9, Doc. 9/125)

Appendix 28

1. Incorporate modified procedures.
(S.G. 4, Report 382-2 (Rev 76), S.G. 4,9, 359-2, S.G. 5, 452-1 (Rev 76), Report AI/5)
2. Lower protection criteria to -222 dB(W/Hz) for d-ep space and permissible interference time to 0.001% for near earth manned in Table II.
(S.G. 2, Recommendation 365-2, Report AL/2, Report 364-2 (Rev 76))
3. Modify to include space research use of antenna gain formula.
(S.G. 2, Recommendation AA/2, Report AC/2)

APPENDIX 29

(No direct changes to Appendix 29 were identified in the existing CCIR documentation.)

5. CONCLUSIONS

There are a number of areas which should have additional technical support in the CCIR. Probably the most important are studies to support proposed new allocations in which two or more services are listed as sharing the same frequency band. A number of sharing situations have been identified from the activities of Ad Hoc 144-Id and have been called to the attention of the various proponent agencies. The correspondence on this is in Appendix D. Although a large number of bands were listed, it is assumed that a number can be handled in combined reports, such as the Army is proposing. (See Army letter in Appendix D.)

Although the areas called out for possible study dealt only with bands above 10 GHz, proponent agencies should review their proposals in the lower frequency bands for possible similar studies.

If Appendix 29 is to be modified and improved, additional technical documentation in the CCIR will be required. Presentations at the recent OTP symposium on coordination procedures would indicate that there is information being developed which could be incorporated into CCIR papers.

Consideration should be given to developing a position proposing that technical criteria be incorporated in the Radio Regulations by reference to the latest CCIR Recommendations

accepted by a CCIR Plenary Assembly. This would be in lieu of listing the criteria directly in the Radio Regulations.

The development of new ground station coordination concepts for mobile-satellite systems, which the Army and Navy have indicated they are pursuing and the development of reference antenna patterns for $D/\lambda < 100$, appear desirable for services other than the broadcasting-satellite service (see AF/10-11). Possibly this latter subject should also be considered in the mobile-satellite area, since it will be one of the heavy users.

Utilization of the geostationary orbit has not been treated extensively, since much of that activity is focusing on preparations for the 1977 WARC. However, any of the results of this effort and the conference should eventually be factored into the preparation for the 1979 GWARC. In terms of CCIR papers, this would generally mean submissions to the Special Joint Meeting of the CCIR in 1978.

Time is very short for those CCIR Study Groups (2, 4, 5, 9, 10, 11) that have their Final Meetings in September-October 1977. Papers must be written and complete the coordination through the U.S. National Committee of CCIR by May in order to meet the deadline for submission of papers to Geneva. The other Study Groups (1, 3, 6, 7, 8) have approximately three additional months since their Final Meetings are not until January.

It would be desirable to have all papers submitted for consideration at the Final Meetings of the Study Groups and then accepted by the CCIR Plenary in 1978. However, in a number of cases, it may not be possible to meet the schedule requirements. Papers can be submitted to the Special Joint Meeting in 1978 and can influence the recommendations of the SJM CCIR to the 1979 GWAARC. The deadline for submission of papers to the SJM will be in the May to July time period 1978, depending on the date selected for the Special Joint Meeting.

APPENDIX A

MATRIX LISTING OF TECHNICAL
DOCUMENTATION AGAINST RADIO REGULATIONS

The matrices contain all the currently available space related CCIR documents. Circles indicate the Radio Regulations to which the documents relate. The solid circles indicate those Regulations that are impacted, either directly or indirectly, and are included in the tabulations of Section 3. The open circles indicate those documents which relate to the Regulations but have no impact.

Due to the redundancy of the CCIR numbering system Recommendations have been underlined to distinguish them from Reports.

A Summary Matrix has been included to show the number of papers from each Study Group that relate to or impact each Radio Regulation.

STUDY GROUP 1 AND 2 PAPERS

IM 1/105

IM 1/106

329-2

AA/2

AB/2

AC/2

AD/2

AE/2

AF/2

AH/2

AI/2

AJ/2

AK/2

AL/2

AN/2

223-3(76)

224-3(76)

226-3(76)

314-3(76)

362-1

363-1

364-2(76)

365-2(76)

367

395-2(76)

396-2

456-1

479

535(76)

BAD. REG.	DESCRIPTION
Art. 1	TERMS AND DEFINITIONS
Art. 2	DESIGNATION OF EMISSIONS
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz
Art. 7 (Task 1)	General or Informative
(470-470VC)	Sec. 1A - Broadcasting Satellite Service
	Sec. VII - Terrestrial Services Sharing with Space
	- Choice of Sites and Frequencies
	- Power Limits
SHARING	Sec. VIII - Space Services Sharing with Terrestrial
	- Choice of Sites and Frequencies
CRITERIA	- Power Limits
	- Minimum Angle of Elevation
	- Limits of P.F.D.
	Sec. IX - Space Radiocommunications Services
	- Cessation of Emissions
	- Control of Interference-Geosta. vs Non-Synch. Sat.
	- Stationkeeping/Space Sta.
	- Pointing Accuracy of Ant. on Geosta. Sat.
	- PFD at Geosta. Sat. Orbit
Art. 12	(INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.
Art. 14	INTERFERENCE & TESTS
App. 3 (Task 3)	TABLE OF FREQUENCY TOLERANCES
App. 4 (Task 4)	TOLERANCE LEVELS OF SPURIOUS EMISSIONS
App. 5	BANDWIDTH AND EMISSION CHAR.
App. 28 (Task 2)	COORDINATION PROCEDURES - Tables I through IV - Figures 4 through 12
App. 29	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS

LEGEND: ● = Direct or indirect impact to Radio Regs.

○ = No impact, relates to Radio Regs.

(no.) = Recommendation

STUDY GROUP 2 PAPERS (Cont.)

RAD. REG.	DESCRIPTION	536(76)	537	539(76)	540	541(76)	542(76)	543	544	545	546(76)	547	548(76)
Art. 1	TERMS AND DEFINITIONS												
Art. 2	DESIGNATION OF EMISSIONS												
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz												
Art. 7 (Task 1)	General or Informative												
(470-470VG)	Sec. IA - Broadcasting Satellite Service												
	Sec. VII - Terrestrial Services Sharing with Space												
	- Choice of Sites and Frequencies												
	- Power Limits												
SHARING	Sec. VIII - Space Services Sharing with Terrestrial												
	- Choice of Sites and Frequencies												
	- Power Limits												
CRITERIA	- Minimum Angle of Elevation												
	- Limits of P.F.D.												
	Sec. IX - Space Radiocommunications Services												
	- Cessation of Emissions												
	- Control of Interference-Geosta. vs Non-Synch. Sat.												
	- Stationkeeping/Space Sta.												
	- Pointing Accuracy of Ant. on Geosta. Sat.												
	- PFD at Geosta. Sat. Orbit												
Art. 12	(INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.												
Art. 14	INTERFERENCE & TESTS												
App. 3 (Task 3)	TABLE OF FREQUENCY TOLERANCES												
App. 4 (Task 4)	TOLERANCE LEVELS OF SPURIOUS EMISSIONS												
App. 5	BANDWIDTH AND EMISSION CHAR.												
App. 28 (Task 2)	COORDINATION PROCEDURES												
	- Tables 1 through IV												
	- Figures 4 through 12												
App. 29	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS												

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 ○ = No impact, relates to Radio Regs.

STUDY GROUP 4 PAPERS

RAD. REG.	DESCRIPTION	IM 4/151	AF/4	IM 4/171	IM 4/174	IM 4/186	IM 4/191	IM 4/193	IM 4/202	204-3	205-3	206-3	207-3	208-3(76)	211-3	212-3	213-3	214-2(76)	352-2(76)	353-2(76)	354-2(76)	382-2(76)	383-2	384-2	385-1	388-2(76)	390-2(76)	391-2(76)	446-1(76)	451-1(76)	453-1(76)
Art. 1	TERMS AND DEFINITIONS																														
Art. 2	DESIGNATION OF EMISSIONS																														
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz																														
Art. 7 (Task 1) (470-470VG)	General or Informative																														
	Sec. IA - Broadcasting Satellite Service																														
	Sec. VII - Terrestrial Services Sharing with Space																														
	- Choice of Sites and Frequencies																														
	- Power Limits																														
	Sec. VIII - Space Services Sharing with Terrestrial																														
	- Choice of Sites and Frequencies																														
	- Power Limits																														
	- Minimum Angle of Elevation																														
	- Limits of P.F.D.																														
	Sec. IX - Space Radiocommunications Services																														
	- Cessation of Emissions																														
	- Control of Interference-Geosta. vs Non-Synch. Sat.																														
	- Stationkeeping/Space Sta.																														
	- Pointing Accuracy of Ant. on Geosta. Sat.																														
	- PFD at Geosta. Sat. Orbit																														
Art. 12	(INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.																														
Art. 14	INTERFERENCE & TESTS																														
App. 3 (Task 3)	TABLE OF FREQUENCY TOLERANCES																														
App. 4 (Task 4)	TOLERANCE LEVELS OF SPURIOUS EMISSIONS																														
App. 5	BANDWIDTH AND EMISSION CHAR.																														
App. 28 (Task 2)	COORDINATION PROCEDURES - Tables I through IV																														
	- Figures 4 through 12																														
App. 29	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS																														

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STUDY GROUP 4 PAPERS (Cont.)

RAD. REG.	DESCRIPTION
Art. 1	TERMS AND DEFINITIONS
Art. 2	DESIGNATION OF EMISSIONS
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz
Art. 7 (Task 1) (470-470VG)	General or Informative
	Sec. IA - Broadcasting Satellite Service
	Sec. VII - Terrestrial Services Sharing with Space
	- Choice of Sites and Frequencies
	- Power Limits
SHARING	Sec. VIII - Space Services Sharing with Terrestrial
CRITERIA	- Choice of Sites and Frequencies
	- Power Limits
	- Minimum Angle of Elevation
	- Limits of P.F.D.
	Sec. IX - Space Radiocommunications Services
	- Cessation of Emissions
	- Control of Interference-Geosta. vs Non-Synch. Sat.
	- Stationkeeping/Space Sta.
	- Pointing Accuracy of Ant. on Geosta. Sat.
	- PFD at Geosta. Sat. Orbit
Art. 12	(INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.
Art. 14	INTERFERENCE & TESTS
App. 3 (Task 3)	TABLE OF FREQUENCY TOLERANCES
App. 4 (Task 4)	TOLERANCE LEVELS OF SPURIOUS EMISSIONS
App. 5	BANDWIDTH AND EMISSION CHAR.
App. 28 (Task 2)	COORDINATION PROCEDURES
	- Tables I through IV
	- Figures 4 through 12
App. 29	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS

LEGEND: ● = Direct or indirect impact to Radio Regs.
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(no.) = Recommendation

STUDY GROUP 5 PAPERS

AA/5
AC/5
AG/5
AI/5
227-1
233-3(76)
234-3(76)
241-2
336-1
369-1(76)
426-1(76)
452-1(76)
453
563(76)
564(76)
565(76)
569(76)

RAD. REG.	DESCRIPTION
Art. 1	TERMS AND DEFINITIONS
Art. 2	DESIGNATION OF EMISSIONS
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz
Art. 7 (Task 1) (470-470VC)	General or Informative Sec. IA - Broadcasting Satellite Service Sec. VII - Terrestrial Services Sharing with Space - Choice of Sites and Frequencies - Power Limits Sec. VIII - Space Services Sharing with Terrestrial - Choice of Sites and Frequencies - Power Limits - Minimum Angle of Elevation - Limits of P.F.D. Sec. IX - Space Radiocommunications Services - Cessation of Emissions - Control of Interference-Geosta. vs Non-Synch. Sat. - Stationkeeping/Space Sta. - Pointing Accuracy of Ant. on Geosta. Sat. - PFD at Geosta. Sat. Orbit (INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.
Art. 12	INTERFERENCE & TESTS
App. 3 (Task 3)	TABLE OF FREQUENCY TOLERANCES
App. 4 (Task 4)	TOLERANCE LEVELS OF SPURIOUS EMISSIONS
App. 5	BANDWIDTH AND EMISSION CHAR.
App. 28 (Task 2)	COORDINATION PROCEDURES - Tables I through IV - Figures 4 through 12
App. 29	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS

LEGEND: ● = Direct or indirect impact to Radio Regs. (no.) = Recommendation
○ = No impact, relates to Radio Regs.

STUDY GROUP 6, 7 AND 8 PAPERS

RAD. REG.	DESCRIPTION	IM 6/149	258-2(76)	263-3(76)	363-3(76)	518-1(76)	AB/8	AJ/8	AL/8	AR/8	AS/8	216-2	361-2	394-1	496	504-1	511	513-1	591(76)	592(76)	593	594	595(76)
Art. 1	TERMS AND DEFINITIONS																						
Art. 2	DESIGNATION OF EMISSIONS																						
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz																						
Art. 7 (Task 1)	General or Informative																						
SHARING	Sec. IA - Broadcasting Satellite Service																						
	Sec. VII - Terrestrial Services Sharing with Space																						
	- Choice of Sites and Frequencies																						
	- Power Limits																						
	Sec. VIII - Space Services Sharing with Terrestrial																						
	- Choice of Sites and Frequencies																						
	- Power Limits																						
	- Minimum Angle of Elevation																						
	- Limits of P.F.D.																						
	Sec. IX - Space Radiocommunications Services																						
CRITERIA	- Cessation of Emissions																						
	- Control of Interference-Geosta. vs Non-Synch. Sat.																						
	- Stationkeeping/Space Sta.																						
	- Pointing Accuracy of Ant. on Geosta. Sat.																						
	- PFD at Geosta. Sat. Orbit																						
	Art. 12 (INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.																						
	Art. 14 INTERFERENCE & TESTS																						
	App. 3 (Task 3) TABLE OF FREQUENCY TOLERANCES																						
	App. 4 (Task 4) TOLERANCE LEVELS OF SPURIOUS EMISSIONS																						
	App. 5 BANDWIDTH AND EMISSION CHAR.																						
App. 28 (Task 2)	COORDINATION PROCEDURES																						
	- Tables I through IV																						
App. 29	- Figures 4 through 12																						
	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS																						

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STUDY GROUP 9 AND 4,9 PAPERS

IM 9/125 IM 9/132 IM 9/179 209-3 355-2 356-3 357-2 358-2 359-3 386-2 387-2(76) 388-2 393-2 406-3 448-1 449-1

RAD. REG.	DESCRIPTION																				
Art. 1	TERMS AND DEFINITIONS																				
Art. 2	DESIGNATION OF EMISSIONS																				
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz																				
Art. 7 (Task 1) (470-470VC)	General or Informative																				
	Sec. IA - Broadcasting Satellite Service																				
	Sec. VII - Terrestrial Services Sharing with Space																				
	- Choice of Sites and Frequencies																				
	- Power Limits																				
	Sec. VIII - Space Services Sharing with Terrestrial																				
	- Choice of Sites and Frequencies																				
	- Power Limits																				
	- Minimum Angle of Elevation																				
	- Limits of P.F.D.																				
	Sec. IX - Space Radiocommunications Services																				
	- Cessation of Emissions																				
	- Control of Interference-Geosta. vs Non-Synch. Sat.																				
	- Stationkeeping/Space Sta.																				
	- Pointing Accuracy of Ant. on Geosta. Sat.																				
Art. 12	- PFD at Geosta. Sat. Orbit (INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.																				
Art. 14	INTERFERENCE & TESTS																				
App. 3 (Task 3)	TABLE OF FREQUENCY TOLERANCES																				
App. 4 (Task 4)	TOLERANCE LEVELS OF SPURIOUS EMISSIONS																				
App. 5	BANDWIDTH AND EMISSION CHAR.																				
App. 28 (Task 2)	COORDINATION PROCEDURES																				
	- Tables 1 through IV																				
	- Figures 4 through 12																				
App. 29	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS																				

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STUDY GROUP 10/11 PAPERS

AA/10-11
AC/10-11
AE/10-11
AF/10-11
AG/10-11
215-3(76)
627(76)
631(76)
632(76)
633(76)
634(76)

RAD. REG.	DESCRIPTION	AA/10-11	AC/10-11	AE/10-11	AF/10-11	AG/10-11	215-3(76)	627(76)	631(76)	632(76)	633(76)	634(76)
Art. 1	TERMS AND DEFINITIONS											
Art. 2	DESIGNATION OF EMISSIONS											
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz											
Art. 7 (Task 1) (470-470VG)	General or Informative											
	Sec. IA - Broadcasting Satellite Service											
	Sec. VII - Terrestrial Services Sharing with Space											
	- Choice of Sites and Frequencies											
	- Power Limits											
	Sec. VIII - Space Services Sharing with Terrestrial											
	- Choice of Sites and Frequencies											
	- Power Limits											
	- Minimum Angle of Elevation											
	- Limits of P.F.D.											
	Sec. IX - Space Radiocommunications Services											
	- Cessation of Emissions											
	- Control of Interference-Geosta. vs Non-Synch. Sat.											
	- Stationkeeping/Space Sta.											
	- Pointing Accuracy of Ant. on Geosta. Sat.											
	- PFD at Geosta. Sat. Orbit											
Art. 12	(INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.											
Art. 14	INTERFERENCE & TESTS											
App. 3 (Task 3)	TABLE OF FREQUENCY TOLERANCES											
App. 4 (Task 4)	TOLERANCE LEVELS OF SPURIOUS EMISSIONS											
App. 5	BANDWIDTH AND EMISSION CHAR.											
App. 28 (Task 2)	COORDINATION PROCEDURES											
	- Tables I through IV											
	- Figures 4 through 12											
App. 29	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS											

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○ = No impact, relates to Radio Regs.

SUMMARY MATRIX

RAD. REG.	DESCRIPTION	U.S. CCIR STUDY GROUP										TSC				TOTAL
		1	2	4	5	6	7	8	4,9; 9	10/11	EMC	PROP	SIDE EFT	STDS	TECH	
Art. 1	TERMS AND DEFINITIONS	1	3	1						1						6
Art. 2	DESIGNATION OF EMISSIONS	1														1
Art. 5	FREQUENCY ALLOCATIONS 10 kHz TO 275 GHz		26	4	6	1		10	1							48
Art. 7 (Task 1) (470-4700G)	General or Informative		2	4												8
	Sec. IA - Broadcasting Satellite Service								3							3
	Sec. VII - Terrestrial Services Sharing with Space		8	1	1	1			4	1						15
	- Choice of Sites and Frequencies		1	1						1						3
	- Power Limits			1				1	1	1						4
	Sec. VIII - Space Services Sharing with Terrestrial		12	1				5	2	1						21
	- Choice of Sites and Frequencies		1							1						2
	- Power Limits			1						1						2
	- Minimum Angle of Elevation															
	- Limits of P.F.D.		3					1	5	3						12
	Sec. IX - Space Radiocommunications Services		5	8	1											14
	- Cessation of Emissions															
	- Control of Interference-Geosta. vs Non-Synch. Sat.															
	- Stationkeeping/Space Sta.			2						1						3
	- Pointing Accuracy of Ant. on Geosta. Sat.		1							1						2
	- PFD at Geosta. Sat. Orbit			2				1								3
Art. 12	(INTERFERENCE) TECH. CHAR. OF EQUIP. & EMISS.		2	2												4
Art. 14	INTERFERENCE & TESTS															
App. 3 (Task 3)	TABLE OF FREQUENCY TOLERANCES															
App. 4 (Task 4)	TOLERANCE LEVELS OF SPURIOUS EMISSIONS	1	2	2					1	1						7
App. 5	BANDWIDTH AND EMISSION CHAR.															
App. 28 (Task 2)	COORDINATION PROCEDURES - Tables 1 through IV - Figures 4 through 12		2	6	10				5	1						24
			6	1					4	1						12
					8											8
App. 29	CALCULATION OF INTERFERENCE BETWEEN GEOSTATIONARY SATELLITES NETWORKS IN SAME FREQUENCY BANDS			10						1						11

NOTES:

Appendices 6, 14, 17A, 19, 20, 20A,B,C, &
Article 13 - N/A to Space

Appendices 28 and 29 relate to Article 9.

APPENDIX B

ABSTRACTS OF INTERIM MEETING
OUTPUT TECHNICAL DOCUMENTATION AND
IMPACTS TO RADIO REGULATIONS

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 2	(IM CCIR 1/105)	<u>Classification and Designation of Emissions</u>

A new method for the designation of emissions is presented. It consists of three symbols for:

- 1) Nature of Emissions (i.e., amplitude-modulated, angle-frequency or phase, pulse, etc.)
- 2) Nature of signal modulating the main carrier (number of channels).
- 3) Type of transmission (i.e., telegraphy, etc.).

With two optional designations:

- 1) Details of signal (e.g., two condition code) color, monochrome, etc), and
- 2) Nature of multiplexing (e.g., frequency or time-division).

New Recommendation

IMPACT: (Art. 2)

This would replace Article 2.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 1	(IM CCIR 1/106)	<u>Definitions of Radiocommunication Inter- ference</u>
		<p>Three new definitions of interference, interfering source and permissible interference are recommended to be employed in ITU texts dealing with radiocommunication interference. In addition, a definition of harmful interference is recommended that is slightly different from the one presently in the Radio Regulations.</p>

New Recommendation

IMPACT: (Art. 1)	<p>Three interference definitions could be added to Article 1. The definition of harmful interference deletes reference to the radionavigation service.</p>
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REFERENCEDOC. NO.TITLE

App. 28,
Art. 9

AA/2
(IM CCIR
2/92)

Generalized Space Research Earth Station
Antenna Radiation Pattern for Use in
Interference Calculations, Including
Coordination Procedures

The document recommends that in the absence of measured data on the levels of peak side lobe response of a space research earth station antenna with a diameter greater than 100 wavelengths and which is subject to interference coordination procedures, a reference radiation pattern (Figure 1 from Recommendation 465) be used to represent the space research earth station side lobe response. Administrations are invited to submit antenna patterns for the purpose of refining the accuracy of this provisional one.

New Recommendation

IMPACT: (App. 28)

If accepted, requires revision to Appendix 28, see AC/2.

REFERENCEDOC. NO.TITLE

App. 4,
Art. 12

AB/2
(IM CCIR
2/130)

Protection of the Radio Astronomy Ser-
vice from Transmitters in Adjacent Bands

Paragraph 116A of the Radio Regulations in many cases does not unambiguously provide needed protection for Radio Astronomy from transmitters operating in frequency bands adjacent to a band allocated to the Radio Astronomy Service. Considering, among other things, the possible future increase in the level of usage of adjacent bands, particularly by airborne and satellite transmitters, it is recommended that all practical technical means (e.g., filters) be adopted in radio astronomy receivers and in adjacent band transmitters. Additionally, frequency assignments to services operating adjacent to a radio astronomy allocation should be made far enough away to prevent any form of interference. Solutions to the problem of band edge interference are sought from the administrations.

New Recommendation

IMPACT: (Art. 12)

(App. 4)

If recommendation is accepted, Article 12 must be revised to cover requirements for filters and for frequency assignments in services in adjacent bands. Appendix 4 should be expanded to cover higher frequencies.

For example: In Article 12

1. All practical technical means, for example the case of filters should be adopted both in radio astronomy receivers and in adjacent band transmitters to the maximum practicable extent, in order to reduce interference to the radio astronomy service.
2. When frequencies are assigned to a station operating in a band adjacent to one allocated on a primary basis to radio astronomy, attempts should be made to limit, (continue as in Recommendation AB/2).

REFERENCEDOC. NO.TITLE

App. 28,
Art. 9

AC/2
(IM CCIR
2/91)

Radiation Diagrams of Antennae at Space
Research Earth Stations for Use in
Interference Studies

In response to issues raised in Question 15/2 and new Study Programme, this document is concerned with the nature of radiation patterns of earth stations in the Space Research Service. It is concluded that the Fixed-Satellite Service reference radiation diagram may be used in interference studies for the Space Research Service where the actual earth station antenna pattern is not known.

New Report

IMPACT: (App. 28)

Supports Recommendation AA/2 (IM 2/92), revision to Appendix 28, Section 3.2 antenna gain formula to include space research service as well as fixed-satellite.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	AD/2 (IM CCIR 2/116)	<u>Probability of Hazards to Personnel Within Aircraft Due to Radiation from Deep Space Earth Stations</u>
		<p>This report specifically analyzes the potential hazard to which personnel in aircraft (especially light aircraft) may be exposed when flying in the vicinity of an earth station in the Deep Space Research Service. Several factors are listed which determine the probability, the aircraft type, the effectiveness of safeguards and the probability of an aircraft entering the actual high power density area of the beam. The annex describes the computations performed. The conclusion drawn was that the probability of a light plane accidentally traversing the high power density region of a transmitting deep space earth station is about one chance in a million.</p> <p style="text-align: center;">New Report</p>
IMPACT:	(General, Radio Regulations)	<p>If the U. S. wishes to add radiation hazards to the Radio Regulations this is an input. Another is in Study Group 4 (IM 4/173).</p>

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5, Art. 7, Section VIII	AE/2 (IM CCIR 2/123)	<u>Preferred Frequency Bands and Power Flux Density Considerations for Earth Explora- tion Satellites</u>

The purpose of this report is to present the factors which influence the selection of frequencies for transmissions of wideband data from earth exploration satellites as well as to present the power flux density levels needed by earth exploration satellite applications. Selection of operating frequencies for housekeeping telemetry and frequency selection and power flux densities for microwave sensors are excluded in this paper and discussed in CCIR Document AF/2 (2/124-E).

New Report

IMPACT: (Art. 5)	Present allocations for EES at 8025-8400 MHz and 21.2-22.0 GHz are inadequate. New allocation vicinity of 15 GHz is required with about 800 MHz bandwidth. About 50 MHz of this would be used for small data acquisition terminals. (NOTE: NASA has proposed EES use in the 17.90-19.90 GHz band sharing with existing services except for a special allocation at 17.90-17.95 GHz for low-cost, no-PFD limit terminals).
(Art. 7, Section VIII)	Radio Regulations 470 NX, -NY, and -NZ must be revised to allow the PFD's required for the low cost terminals at 17.70-17.75 GHz.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 1, Art. 5, Art. 7, Section VIII	AF/2 (IM CCIR 2/124)	<u>Technical and Operational Considerations for the Earth Exploration Satellite Service Preferred Frequency Bands and Sharing Considerations for Active and Passive Microwave Sensors</u>

The purpose of this report is to present the preferred frequency bands and the expected characteristics of microwave sensors under development for these satellites, and to evaluate the possibilities for sharing frequency bands between microwave sensors and other users of the microwave spectrum. Several conclusions are drawn.

New Report

IMPACT: (Art. 5) Report lists a number of bands which may be used by passive sensors. Some are existing Radio Astronomy and Space Research bands but others would require new allocations. Report concludes that active sensors may probably share Radiolocation bands. (Note: Specific proposals have been made for active and passive sensors).

(Art. 7,
Section VIII) No impact.

(Art. 1) A definition is needed to recognize the use of active space sensors. For example:

57A Radiolocation Space Station: A station in the Radiolocation Service intended to be used on a space vehicle.

(This approach is taken, rather than defining a space Radiolocation Service, in order to indicate that operation is in existing radiolocation bands.)

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VIII	AH/2 (IM CCIR 2/133)	<u>Preliminary Analysis of Low-Orbit Satellite Visibility Statistics</u>
		<p>The document is a new Report intended to be one of a series concerned with the major statistical and geometric aspects of potential interference from low orbit inclined space research spacecraft to terrestrial services and to the terrestrial segments of space services. Presented is an analytical model and a computation of long-term visibility statistics of a satellite in a random circular orbit from a given earth station. Parameters considered include altitude of the spacecraft, orbit inclination, latitude of the earth station, earth station antenna pointing azimuth, elevation, and beamwidth. Several graphs summarizing the results of the analysis are given. The computer simulation used in the analysis is included as an Annex.</p> <p style="text-align: right;">New Report (relates to Question 1/2; Study Programme 1B/2)</p>
IMPACT:	(Art. 7)	Information can be used to develop interference criteria from low altitude satellites that are different (higher PFD's) from those in Article 7 which deal primarily with stationary satellites.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Sections VII & VIII, Art. 5	AI/2 (IM CCIR 2/136)	<u>Factors Affecting the Possibility of Frequency Sharing Between Radio Astronomy and Other Services</u>
		<p>The purpose of this report is to provide guidelines under which the possibilities of frequency sharing should be considered. Sources of interference are described and some conclusions are drawn on the possibilities of frequency sharing.</p> <p style="text-align: center;">New Report</p>
IMPACT:	(Art. 7, Sections VII & VIII)	<p>This Report in conjunction with Report 224-3 on protection criteria can be used to develop Regulations on sharing of other services and radio astronomy. A new section in Article 7 could be developed for radio astronomy sharing with space and terrestrial services or Footnote 233B.</p>
	(Art. 5)	<p>Article 5 could be revised by adding: "Taking into account the protection criteria and sharing considerations of CCIR Reports 224-3 and AI/2". The specific bands mentioned in 233B could be modified if additional shared bands are allocated to radio astronomy.</p>

REFERENCEDOC. NO.TITLE

Art. 5

AJ/2
(IM CCIR
2/153)Feasibility of Sharing Between Space Re-
search Satellites in Eccentric Orbits
and Deep Space Research Earth Stations
(Question 14-1/2)

The report describes potential interference situations between spacecraft operating in highly elliptic orbits and deep space network ground stations sharing the band 2290-2300 MHz. Levels of harmful interference to the deep space network earth stations is presented and compared with the levels of interference power density produced at the earth station by an assumed highly elliptical spacecraft operating on a co-channel basis.

The conclusion drawn is that sharing is not feasible based on the observation of the orbit and spacecraft parameters assumed in this analysis.

New Report

IMPACT: (Art. 5)

Supports revision of allocation to
Space Research (Deep Space Only).

REFERENCEDOC. NO.TITLE

Art. 5
Art. 12

AK/2
(IM CCIR
2/110)

Interference to the Radio Astronomy Service from Transmitters in Other Bands

This report deals with interference to radio astronomy by transmitters in another band and definitions and examples are given of the two classes of out-of-band interference. In addition, consideration is given to the design of a radio astronomy receiver to minimize the interference problem. Annex I is an amended version of Annex II of Report 224-3 and presents factors relating to possible interference from terrestrial UHF television transmissions. Annex II is a revision of Annex III of Report 224-3 and describes the technical factors relating to the protection of radio astronomy observations from interference by satellite transmissions. Annex III is an amended version of Report 547 which deals with the sensitivity of radio astronomy receivers to signals in adjacent bands.

New Report

IMPACT: (Art. 5)

Report concludes that allocation of high power services such as TV broadcast or space services adjacent to radio astronomy bands may lead to significant sharing problems.

(Art. 12)

Report investigates interference to radio astronomy receivers via harmonic and IM radiation from spacecraft and television transmissions.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5, Art. 7, Section VIII, Art. 9, App. 28	AL/2 (IM CCIR 2/145)	<u>Protection Criteria and Sharing Considerations Relating to Deep Space Research (Question 1/2 (Rev 1976) (Doc. 2/28) Study Programme (Doc. 2/127))</u>

This report deals with the potential interference between deep space research and other radio communication services. Considered are earth station power levels, site locations, antenna pointing and patterns, near earth satellite orbits, receiver characteristics, interference characteristics, levels, and time factors. The deep space spacecraft receiver, antenna and transmitter characteristics are delineated. The deep space link parameters are compared with parameters for both near earth and terrestrial services for possible interference situations. The conclusions reached are, based on the evidence at the moment, sharing appears feasible with terrestrial services under specific conditions and constraints, but more study is required of airborne transmitters, other cases involving near earth satellites and cases of adjacent and harmonically related band operation. Additional study of the effect of transhorizon systems on deep space transmissions is also required.

This document treats the general sharing problem and relates directly to Sections VII, VIII and IX of Article 7 as well as Appendix 28.

New Report

IMPACT: (Article 7, VIII) Reports indicating that existing PFD limits and earth station constraints for deep space bands are acceptable.

A potential problem area, however, is interference from airborne transmitters and interference to and from transhorizon systems.

Information on potential interference to geostationary spacecraft is given and indicates that sharing with either low orbit spacecraft or geostationary spacecraft should be avoided.

In general, this report does not suggest any changes to Article 7.

- (Article 5) Report indicates possible sharing problems between deep space systems and other space systems, tropo systems and airborne transmitters.
- (Appendix 28) Recommend earth station protection level is given as -222 dBW/Hz for .001% of the time for deep space research systems (old value -220).

REFERENCEDOC. NO.TITLE

Art. 5,
Art. 7,
Sections
VII, VIII,
& IX

AN/2
(IM CCIR
2/142)

Preferred Frequency Bands for Deep Space
Manned and Unmanned Spacecraft (Question
2-1/2)

This Report presents considerations which affect the choice of frequencies for use in deep-space research for both manned and unmanned spacecraft. Present bandwidth requirements are described briefly due to extensive treatment in earlier reports. Future bandwidth requirements consist of increased use of video data, increased data rates, multiple spacecraft, use of coded modulation and greater accuracy of radionavigation. Additionally, phase coherency requirements, antenna gain considerations and transceiver efficiency are discussed along with atmospheric effects on deep space propagation. Several conclusions are drawn regarding communication requirements and the constraints on the frequency organization necessary due to those requirements.

In treating future frequency requirements of deep space research, the paper is related to Article 7, Sections VII, VIII and IX, as well as Article 5.

New Report

- IMPACT: (Article 5) Report gives rationale for two sets of paired bands below 10 GHz (satisfied by existing allocations), a third set of paired bands between 15 and 20 GHz and the need for bands above 20 GHz.
- (Article 7) With the exception of effects caused by changes to Article 5, this report suggests no changes to Article 7.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	223-3 (Rev. 76) (IM CCIR 2/83, 2/84)	<u>Line Frequencies, Arising from Natural Phenomena, of Interest to Radio Astronomy and Related Sciences</u>

Report 223-3 consists of a summary description of radio frequency lines which interest radio astronomers and some of the phenomena and molecules that are the source of these lines. The Annexes summarize the types of observations that are being conducted at observatories throughout the world, using line frequencies that are afforded some measure of protection through international agreement in the Radio Regulations.

The revision changes some of the frequency lines in the Tables and replaces text to update information regarding phenomena of interest.

Revision of
Report 223-3

IMPACT: (Art. 5)

No direct impact. Supports Recommendation 314-3 (Rev. 76) and shows many other frequencies of interest to radio astronomy which are not protected by allocations.

REFERENCEDOC. NO.TITLE

Art. 5,
Art. 7

224-3
(Rev. 76)
(IM CCIR
2/138)

Characteristics and Protection Criteria
of the Radio Astronomy Service

Report 224-3 presents a brief description of radio astronomy, its history, and the work it involves. The origin and nature of various emissions, radio astronomy is interested in, are also described along with the classes of observations based on one of the two primary factors, equipment sensitivity or continuity of observation. Sources of interference are listed as well as references where the details of radio astronomy observatories are located. Finally, levels of harmful interference are discussed and several conclusions are drawn on frequency sharing (such as the need for higher altitude transmissions above 10 and 20 GHz to avoid atmospheric attenuation leads to shielding difficulties).

Annex I presents interference criteria for Class B observations. Annex II discusses possible interference from terrestrial UHF television transmissions and Annex III considers interference by satellite transmissions.

The revision replaces the annexes with one small Annex I consisting of a table of the radio frequency lines that presently are of the greatest importance to radio astronomy. Additionally, the text is modified and reduced to two sections. The first part of the report contains definitions and descriptions of the phenomena and emissions which concern the Radio Astronomy Service. The second section of the report describes the sensitivity of the radio astronomy systems, types of interference and techniques for reducing the interference.

Revision of Report 224-3

IMPACT:

See Report AI/2

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5, Art. 7, Sections VII & VIII	226-3 (Rev. 76) (IM CCIR 2/86)	<u>Factors Affecting the Possibility of Frequency Sharing Between Radar Astronomy and Other Services</u>

Some factors are presented that affect sharing with radar astronomy. Certain conclusions are drawn regarding management of interference, the effect of natural phenomena (e.g., solar) on frequency range, etc. Table I consists of a comparison of some systems of radar astronomy. The revision replaces Table I with another table containing additional information.

Revision of
Report 226-3

IMPACT: (Art. 5)	Could add a Footnote in 5 to the effect that where sharing is impossible, a channel of modest bandwidth within the radio-location bands concerned may be cleared or protected on a local or regional basis for certain radar astronomy experiments.
(Art. 7, Section VII & VIII	No impact.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5, Art. 7, Sections VII & VIII	314-3 (Rev. 76) (IM CCIR 2/81, 2/82)	<u>Protection of Frequencies Used for Radio Astronomical Measurements</u>
		Observations of known spectral lines requires certain frequency bands. Considering the benefit of improved receiving techniques, due to radio astronomy, Doppler shift, occultations of radio sources by the Moon, sensitivity of radio astronomical receiving equipment, harmful interference may be caused by reflection of transmissions by Moon, aircraft, etc, the occasional need for uninterrupted recording or simultaneous reception, certain recommendations are proposed regarding site selection and improved protection. Document 2/81 proposes amendments that broaden the frequency range to be protected for radio astronomy.

Revision of
Recommendation 314-3

IMPACT: (Article 7) Recommends improved world-wide protection for 11 radio astronomy line frequency bands covering the region 1390 MHz to 115.5 GHz. Impact to Article 7/VII and VIII could come about either by specifying protection criteria or via higher status allocations for radio astronomy measurements in Article 5. In addition, an allocation near 10 MHz (Article 5) and better protection for all radio astronomy bands above 20 MHz is recommended.

If additional protection is to be included in Article 7 for the aforementioned radio astronomy bands, Report 224-3 (2/138) contains specific sharing values.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 1, Art. 5	362-1 (SG 2) (IM CCIR 2/157)	<p><u>Frequencies Technically Suitable for Meteorological Satellites</u></p> <p>Certain bands are presently allocated internationally to the Meteorological Aids Service and certain of the frequency needs of meteorological satellites may be satisfied through the use of the present meteorological aids allocations.</p> <p>The bands 8, 9 and 10 are technically suitable for narrow and wideband meteorological data transmission, as well as tracking, maintenance telemetry and telecommand. Frequencies allocated to the Radiolocation Services in Bands 10 and 11 are suitable for the precipitation detection radar and cloud detection radar onboard meteorological satellites.</p> <p style="text-align: right;">Recommendation 362-1</p>
IMPACT:	(Art. 5)	Meteorological satellite references (in bands 8, 9 and 10) presently marked space-to-earth, will have to be changed to non-directional for the telecommand and meteorological aids to include meteorological satellites.
	(Art. 1)	Radiolocation must be defined to include satellite-borne radar.

REF.DOC. NO.TITLE

Art. 5

363-1
(SG 2)Preferred Frequency Bands for Use in
Maintenance Telemetry, Tracking and
Telecommand of Developmental and Opera-
tional Satellites

The frequency bands below 1 GHz are technically suitable for some types of maintenance telemetry, tracking and telecommand of developmental and operational satellites. The bands between 1 and 15 GHz are suitable for maintenance telemetry, precision tracking systems, tracking and telecommand, particularly for high altitude satellites. Above 10 GHz is suitable during re-entry of satellites into the Earth's atmosphere. Therefore, for spectrum efficiency, use of frequencies within the operational bands used for data transmission or communications should be considered for maintenance telemetry, tracking and telecommand, where feasible.

Recommendation 363-1

IMPACT: (Art. 5)

100 MHz - 15 GHz allocations for space operation (telemetry & tracking) maintenance and meteorological-satellite, meteorological aids, radionavigation-satellite and communication-satellite are all revised to indicate that maintenance telemetry, tracking and telecommand is permitted as well as data transmission and communications.

REFERENCEDOC. NO.TITLE

Art. 5
Art. 7
Sections
VIII & IX,
App. 28

364-2 (Rev. 76)
(IM CCIR
2/115)

Telecommunication Links for Manned and
Unmanned Near Earth Research Satellites
Frequencies, Bandwidths and Protection
Criteria from Interference

Considering operating frequencies, bandwidths, interference criteria, the number of satellites, system noise temperatures, antenna angles, coding, doppler shifts, practical spacecraft transponder implementation, earth station site limitations and other technical requirements, Recommendation 364-2 suggests specific frequencies, bandwidths, power spectral densities for interference and interference vs. time criteria for near earth research satellites. This document offers several revisions. Principally, the range of suitable radio frequencies for near-earth space research links is extended from 10 GHz to 30 GHz by shifting the 300 MHz to 1000 MHz range to 1 and 46 GHz respectively, and the required RF emission bandwidths for mission telemetry are increased. The minimum earth station-to-satellite antenna elevation angle is changed from 3° to 5°. The permissible PFD value for above 300 MHz is lowered to -171 dBW per kHz not to exceed five minutes/day for manned missions and -161 dBW/kHz for .1% time is retained for other near earth mission. The revision combines part of Recommendation 366-1 with Recommendation 364-2, and Recommendation 366-1 is suppressed.

This document relates generally to Sections VIII and IX of Article 7 in defining interference levels at input of space research earth stations and satellites. It also relates to Article 5.

Revision of
Recommendation 364-2

IMPACT: (Art. 5)

No direct impact but upper limit of usable frequencies is raised from 10 GHz to 30 GHz.

(Art. 7,
App. 28)

No impact on earth stations. -220 dB (W/Hz) remains the same as Appendix 28 although if new space research bands are allocated Appendix 28 would have to include them. Values are given for protection of space research satellites. The Radio Regulations do not cover this.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28, Art. 5, Art. 7, Art. 9 Sections VII & IX Art. 9	365-2 (Rev. 76) (IM CCIR 2/144)	<u>Telecommunication Links for Manned and Unmanned Deep Space Research Frequencies, Bandwidths and Interference Criteria (Question 2-1/2)</u>
		Suitable frequencies, required bandwidths and interference criteria are recommended based on technical considerations of the effects of noise and atmosphere, the necessity for precision tracking, system noise temperature, antenna surface tolerances and doppler shift.
		The revision includes in the Recommendations higher frequencies and wider bandwidths, with additional low frequency bands, lower levels of interference, some sharing criteria, use of emergency frequencies for manned mission emergencies, the necessity of two way communication for manned missions and further study of future manned mission requirements.
		This document combines Recommendations 365-2 and part of 366-1.
		Revision of Recommendation 365-2

IMPACT:

Should be combined with Reports AN/2 and AL/2.

This Recommendation is proposing frequency bands and protection requirements for earth stations in the deep space network and therefore is related to Sections VII and IX of Article 7. Introduction of earth station interference criterion impacts Appendix 28.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	367 (SG 2)	<u>Frequency Bands for Re-Entry Communications</u>

The only proven solution to the re-entry communication problem to date involves the use of frequencies greater than the critical frequency of the plasma sheath surrounding and induced by the re-entering satellite. The critical frequencies of the plasma can approach or exceed 10 GHz but frequencies of 10 GHz and higher are affected appreciably by the Earth's atmosphere. Space Research bands above 15 GHz are suitable technically for some re-entry communications. It is recommended that all this be taken into account when considering the selection of frequencies for re-entry communications.

Recommendation 367

IMPACT: (Art. 5)	No impact to Article 5; desire to use space research allocations already there.
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<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5, Art. 7, Section VIII	395-2 (Rev. 76) (IM CCIR 2/125)	<u>Radio communications for Meteorological Satellite Systems</u> Report 395-2 presents a survey of the spectrum utilization and the frequency requirements of present and planned meteorological satellite programs. Technical characteristics of the present and planned meteorological satellites are given in Annex I and a brief discussion of sensing techniques is given in Annex II. Annex III consists of typical interference calculations and discussion. The revision suppresses all three existing annexes incorporating much of the information regarding satellite systems in the main text. A new Annex provides brief descriptions of operational and proposed meteorological satellite systems. Revision of Report 395-2
IMPACT:	(Art. 5)	Generally defends existing allocations. States requirement for 300 MHz wide band telemetry for advanced meteorological systems in Band 10.
	(Art. 7, Section VIII)	No direct impact to Radio Regulations. (Paper refers to sharing criteria for passive and active sensors in Report AF/2.)

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5,	396-2 (SG 2)	<u>Maintenance Telemetry, Tracking and Telecommand for Developmental and Operational Satellites</u> <u>Possibilities of frequency sharing between earth satellite telemetry or telecommand links and terrestrial services</u>

The discussion is concerned with relative levels of interference in various cases to determine whether there is an a priori basis for sharing. Eleven cases of frequency sharing for telemetry and eleven for telecommand are considered. Immediately, sharing which involves the use of a frequency for transmitting in some satellites, and which others use the same frequency for receiving was discounted as infeasible. Other cases required greater consideration.

Report 396-2

IMPACT: (Art. 5,)

Supports Recommendation 363-1. It indicates continuing requirements for space operation bands below 1 GHz.

REFERENCEDOC. NO.TITLE

Art. 5

456-1
(Rev. 76)
(IM CCIR
2/137)Preferred Frequency Bands for Spacecraft
Transmitters Used as Beacons

The document is a revision of Report 456-1, which is concerned with preferred frequency bands for spacecraft beacon transmitters. The revision adds text concerned with the use of the beacons in studies of atmospheric propagation at frequencies above 10 GHz. The added text reflects the characteristics of several current and previous radio beacon experiments.

Revision of Report 456-1
(relates to Question 10/2)

IMPACT: (Art. 5)

Report indicates needs for additional
beacon frequencies as follows:

(1) Doppler & Faraday measurements

- (a) Frequency in range of 80 to 200 MHz harmonically related to 20 GHz
- (b) Additional protection at 41 MHz is desired for Faraday rotation measurements (Footnote 236A)

(2) Atmospheric measurements

- (a) Frequencies near 15, 20 and 30 GHz are required
- (b) Frequencies near 90 and 150 GHz probably are required

(3) Geodetic

- (a) Frequencies more simply related to 150 and 400 MHz are desired
- (b) Frequencies higher than and harmonically related to 400 MHz is required

Report notes that sharing beacon frequencies has proved to be very difficult.

REF.DOC. NO.TITLE

Art. 5

479
(SG 2)Protection of Frequencies for Radio-
astronomical Measurements on the Shielded
Side of the Moon

Considering the importance of the shielded side of the moon to radio astronomy and passive space research free from atmospheric hindrances, Recommendations are made to take into account the need to provide for radio astronomy observations on the shielded area of the moon in planning the spectrum with special attention given to those frequency bands in which observations are difficult or impossible from the surface of the Earth.

Recommendation 479

IMPACT: (Art. 5)

No impact to deep space because Report 539 includes a decision to work around deep space research bands. Would impact other services who operate above 100,000 km above earth.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5, Art. 7, Sections VII & VIII	535 (Rev. 76) (IM CCIR 2/108)	<u>Technical and Operational Considerations for the Earth Exploration Satellite Services</u>
		Report 535 discusses some of the technical and operational parameters of U. S. systems that will operate within the Earth Exploration Satellite Service. Several of the various systems and types of systems are listed and described as well as data rates, PFD's and sensor payloads.
		The revision updates the information with regard to certain systems (e.g., ERTS is changed to Landsat). Launch schedules are changed as well as some technical information.
		Revision of Report 535
IMPACT:	(Art. 5)	Report mentions possible need for allocations for both passive and active sensors and suggests that radiolocation and active sensors can "appear" to share the same bands. More information given in AE/2.
	(Art. 7)	This report puts forth several rationale for increasing PFD limits from EES spacecraft (Article 7/VIII), however, no suggested values are given. Requirements specified in more detail in AE/2.
	(Art. 5)	Report suggests that optimum EES band may not be either 8025 or 21.2-22.0 GHz but does not suggest alternative. Requirements specified in more detail in AE/2.

REFERENCEDOC. NO.TITLE

App. 28,
Art. 7
Sections
VII, VIII
and IX,
Art. 5

536 (Rev. 76)
(IM CCIR
2/143)

Telecommunication Requirements for
Manned and Unmanned Deep Space Research

Report 536 presents a summary of the technical characteristics and system parameters of telecommunication systems for manned and unmanned deep space research. Additionally, required bandwidths and interference criteria are presented. Sharing between the deep space stations and line-of-sight radio-relay systems is feasible at a prescribed PFD limit for the line-of-sight systems and mention is made of interference from trans-horizon radio-relay systems. Annex I describes the factors affecting radio-frequency power requirements for deep space research telecommunication links. Annex II presents the effect of changes in technology on the selection of frequencies for deep space research mission links.

This document is a detailed and updated description of the functional U.S. requirements for deep space research telecommunications systems and system parameters and characteristics (trajectory and propagation information, bit rates, communication distances and continuation requirements, future use of television, modulation, power and bandwidth requirements, transmitter antenna parameters, receiver parameters, etc.).

Revision of
Report 536

IMPACT: (Article 7) Report is a summary of technical details and operational schemes of deep space research. It does not impact Article 7, VII, VIII or IX specifically.

(Appendix 28) Same as above.

(Article 5) Defends existing allocations.

REF.

DOC. NO.

TITLE

Art. 5

537
(SG 2)

Technical Characteristics of Radio Links
Between Earth Stations and Research
Spacecraft by Means of Space Stations
In Bands 8, 9, 10 and 11

This Report presents a summary of technical characteristics and system parameters of telecommunications links in bands 8, 9, 10 and 11, between earth stations and near-earth orbiting space stations, which use one or more geostationary satellites as intermediate relays.

The possibility of using data relay space stations is mentioned in Report 548. The present Report will indicate the extent to which the conclusions of Report 548 are affected by arrangements which use intermediate satellites, as compared with direct communication between earth stations and earth orbiting mission spacecraft.

Report 537

IMPACT: (Art 5)

No Recommendation follows and no immediate impact except to support future possible needed revisions to allocations to provide for TDRS frequency requirements.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5, Art. 7, Section IX, Rec. Spa 2-8	539 (Rev. 76) (IM CCIR 2/105)	<u>The Protection of Radio Astronomy Observations on the Shielded Side of the Moon</u> Report 539 explains the importance of the other side of the moon to radio astronomy due to the congestion of the spectrum on earth and negative atmospheric effects on transmission. However, some protection is still required for lunar quiet zone signals and suggestions are made regarding methods. The revision removes the frequency Table (I). In addition, it replaces and adds text very similar to the previous text. In one case, the shielded zone of the Moon in the revision is determined by the line of sight from the 100,000 km orbit rather than as in the original text by the limits of the earth surface line of sight. Revision of Report 539
IMPACT:	(Art. 5)	Specific bands to be protected are not listed. However, guidelines are presented from which bands could be determined.
	(Art. 7, Section IX)	If protection is provided along the lines of this report, Article 7 will have to be revised for coordination of frequency use with radio astronomy service at farther than 100 km from earth.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5 Art. 7, Section VIII	540 (SG 2)	<u>Feasibility of Frequency Sharing Between an Earth Exploration Satellite (EES) System and Fixed Satellite, Meteorological Satellite and Terrestrial Fixed and Mobile Services</u>

The technical feasibility of frequency sharing between EES and Terrestrial Fixed and Mobile Services, fixed satellites and meteorological satellites is discussed in this Report. All are feasible following certain limits and criteria stated.

Report 540

IMPACT: (Art. 7,
Section VIII) See new Report AE/2 (IM CCIR 2/123).

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Sections VII & VIII	541 (Rev. 76) (IM CCIR 2/129)	<u>Feasibility of Frequency Sharing Between a Geostationary Meteorological Satellite System and the Meteorological Aids Service in the Region of 400 MHz and in the Upper Part of Band 9 (1 to 3 GHz)</u>

Report 541 describes typical meteorological aids and satellite systems that may share frequency bands in the region of 400 MHz and in the upper part of Band 9 (1 to 3 GHz) along with sharing criteria.

The revision replaces Tables III and IV (METEOSAT satellite system characteristics) with updated material and there are several changes in the text in order to update or make minor corrections.

Revision of Report 541

IMPACT:	(Article 7 GEN.)	(Note: European submittal) Revision concludes that sharing between Met Sats (METEOSAT specifically) and Met Aids (radio-sondes) is feasible if met aid is e.i.r.p. limited and coordination is carried out possibly via the World Meteorological Organization. No changes to Article 7 are suggested.
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<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7	542 (Rev. 76) (IM CCIR 2/112)	<u>Technical Feasibility of Frequency Sharing by the Amateur Satellite Service</u> <u>Interference Potential of Amateur Satel- lites in Shared Bands</u>

Report 542 illustrates the feasibility of sharing between the Amateur-Satellite Service and the Radiolocation Service and reports on other experiments performed in the AMSAT-OSCAR program.

The revision changes the main text to an Annex (II). Annex I consists of technical characteristics of the AMSAT OSCAR spacecrafts 6 and 7. Annex III is an interference analysis. The new main text presents the Annexes.

Revision of Report 542

IMPACT: (Art. 7)

No impact to Radio Regulations.

REF.

DOC. NO.

TITLE

N/A

543
(SG 2)

Safety Aspects of Radio Frequency Radiation from Space Research Earth Stations
Comparison between predicted and measured field strengths at 2 GHz

This Report describes and compares calculations and actual system tests used to determine power flux density in the vicinity of a large (64 m) diameter reflector antenna with an input of 400 kW in the vicinity of 2 GHz. In this analysis, power flux densities greater than 10 mW/cm² are examined in the greatest detail since they may be considered as being potentially dangerous to human beings exposed to the radiation [USA Standard, 1966]. Intermediate densities, from 1 to 10 mW/cm², are covered in lesser detail, since this category is considered safe for occasional exposure. Densities less than 1 mW/cm² are examined, although radiation in this category is considered safe for indefinite exposure. Certain restrictions regarding personnel movement and environmental restrictions in the area of the main beam are determined.

Report 543

IMPACT:

None; may eventually lead to setting of international standards for radiation safety.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	544 (SG 2)	<u>The Effects of Interference on Narrow-band Phase Locked Loops As Used in Space Research</u>

An experimental investigation of the effects of interference on narrow-band phase-locked loops has been conducted to determine the degree of performance degradation caused by interfering signals on the ground station receivers of space research communication systems. A summary of the results of this investigation is presented.

Report 544

IMPACT: See Report 545.

REF.DOC. NO.TITLE

App. 28

545
(SG 2)The Effects of Interference on Research
Spacecraft Telemetry

This Report presents a discussion of the effect of interfering signals in the passband of a telemetry or telecommand link between earth stations and a space research spacecraft. The purpose of the Report is to provide information on the effect of interference on the pulse code modulation bit detection process, as well as information on the various classes of research spacecraft data. The Report also considers the calculation of an acceptable interference power level, and uses the results to compute an interference criterion in agreement with the presently defined value of -220 dBW/Hz for the maximum spectral density of noiselike interference. (Report 544 discusses the effect of interfering signals on phase locked loops which are used as carrier and subcarrier demodulators for research spacecraft links, therefore, it is not dealt with in this Report).

Report 545

IMPACT:

No impact from this paper. However, (IM CCIR 2/145) AL/2 lowers the interference level for deep space vehicles to -222 dBW/Hz which will change it in Table II of Appendix 28.

REFERENCEDOC. NO.TITLE

Art. 7,
Section IX

546 (Rev. 76)
(IM CCIR
2/94)

Space Systems Technology in the Space Re-
search Service: Attitude Control Tech-
nology

Report 546 describes various techniques for attitude control used in the United States space research program and discusses some of the factors that affect the accuracy of control systems.

The revisions consist mostly of minor changes such as words or phrases for purposes of clarifying the text.

Revision of Report 546

IMPACT: (Art. 7,
Section IX)

No present impact on (470VF) Section IX of Article 7; Supports future changes to pointing accuracy and sets limit to accuracy attainable or worth bothering with.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VIII App. 4	547 (SG 2)	<u>Sensitivity of Radio Astronomy Receivers to Signals in Adjacent Bands</u>
		<p>Radioastronomical observations fall into two main categories: broadband observations, in which the total power within a specified passband is measured (continuum measurements), and spectral-line observations, in which intrinsically narrow-band measurements are made over a range of center frequencies. In continuum measurements the achievement of maximum sensitivity requires the use of the largest possible bandwidth consistent with rejection of out-of-band signals; for line measurements the band of interest is determined by the characteristics of the source being observed and the effect of any Doppler velocities which may be present. This Report considers the restrictions imposed on the observations by the need to reject adequately those signals likely to be present in adjacent bands. The discussion and conclusions apply mainly to continuum measurements with single antennae; spectral line and interferometer observations are however included where the considerations are different.</p> <p>The conclusions indicate two potential problem areas: use of interferometer techniques precluding the adoption of the most effective filter designs and two or more strong signals (peak power 10^{-7} W) or spectral components of one signal close to the edge of the radio astronomy band.</p> <p style="text-align: right;">Report 547</p>
IMPACT:	(Art. 7, Section VIII App. 4)	System design considerations in location of radio astronomy antenna site limit number of signals to one with peak power in that area (10^{-7} W) (or probably lower to allow more users of the band).

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 1, Art. 5, Art. 7	548 (Rev. 76) (IM CCIR 2/106, 2/122, 2/156)	<u>Telecommunication Requirements for Manned and Unmanned Near Earth Space Research (Questions 1/2 and 2-1/2)</u>
		<p>Report 548 presents a summary of the technical characteristics and system parameters of telecommunication systems in near earth Space Research Services. The discussions provide a foundation for establishing the radio frequency spectrum requirements for Space Research Services and for frequency sharing between Space Research Services and various terrestrial services. Discussions include types of missions, communication requirements, spectrum requirements, equipment, and sharing and interference considerations.</p> <p>The revision makes specific changes to report paragraphs 3.1.2, 4.1, 4.1.4, 6.1 and to Tables I and II. These changes increase the upper suitable frequency range from 15 to 30 GHz, and RF bandwidths in the highest frequency from 100 to 300 MHz. Additionally, voice is added to the types of signal for each frequency range in Table I with its corresponding RF bandwidth per link.</p> <p>A definition is included for near earth space and the low orbit of a satellite.</p> <p>This document relates generally to Article 5 and also Articles 1 and 7.</p> <p style="text-align: right;">Revision of Report 548</p>
IMPACT:	(Art. 1)	If definitions proposed for near earth space and low orbit (of a satellite) are accepted they could be added to Article 1.
	(Art. 5)	No direct impact but supports Recommendation 364-2 (Rev. 76).
	(Art. 7)	No impact.

REFERENCE

DOC. NO.

TITLE

Art. 7,
Section IX,
App. 29

(IM CCIR
4/151)

Interference Allocation of A Digital
System In The Fixed Satellite Service

The purpose of this Report is to identify possible sources of inter-satellite interference. A preliminary budget of interference powers and an example for a 4-phase CPSK system are given.

New Report

IMPACT:

(Appendix 29)

Suggests including polarization to spacing of satellites in orbit.

(Article 7,
Section IX)

Factors increasing the utility of the geostationary orbit should be included in Article 7, Section IX.

The technical basis for a definite decision is not yet available.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 12, App. 4	AF/4 (IM CCIR 4/194)	<u>Factors Concerning the Protection of Fixed-Satellite Earth Stations Operating in Adjacent Frequency Band Allocations Against Spurious Emissions from 12 GHz Broadcasting Satellites</u>

The factors involved in the protection of fixed satellite earth stations from spurious emissions from adjacent broadcasting satellites at 12 GHz are presented as well as the implications and conclusions. The factors considered are worst-case maximum permissible levels of spectral PFD at the interfered with receivers, protection approaches, and examples of satellite spacing and/or frequency separation.

New Report

IMPACT: (Article 12, App. 4)	Suggests further efforts to refine tentative conclusions in report on spurious emissions into fixed-satellite systems. (No specific impact until further work is done.)
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REFERENCEDOC. NO.TITLE

N/A

(IM CCIR
4/171)Availability of Circuits in the Fixed-Satellite Service

This Report discusses various parts of Question 24/4 on how the concept of availability could be applied to the hypothetical reference circuit in the Fixed-Satellite Service for telephony and television. It suggests a philosophy which could be applied and some of the parameters which could be specified in deriving meaningful availability criteria for telephony and television circuits in the Fixed-Satellite Service and results of practical experience in two countries are presented.

New Report

IMPACT: No impact on Radio Regulations.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VII App. 28	(IM CCIR 4/174)	<u>Earth Station Antenna Coupling and Collocation in a Shared Frequency Band</u>

A measurement program is presented involving a coupling factor which demonstrates the feasibility of collocating a terrestrial antenna sharing the same frequency band under specific conditions.

New Report

IMPACT:	(Article 7, Section VII)	This paper indicates that under certain circumstances the co-channel (Earth Station/Terrestrial Relay) coordination distance can be zero. No impact.
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	(App. 28)	No impact.
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REFERENCEDOC. NO.TITLE

Art. 12,
App. 4

(IM CCIR
4/186)

The Radiation of Spurious Emissions from
Earth Stations and Space Stations of the
Fixed-Satellite Service

This report includes the nature and possible power level of spurious emissions radiated from earth and space stations, the levels of permissible interference at a receiving station and the possibilities for the form in which to present the power limits. Very tentative conclusions are drawn on each. Study Groups 2 and 4 are called on to determine compromise criteria for spurious emissions.

New Report

IMPACT: (Article 12,
App. 4)

Suggests further efforts to refine tentative conclusions in report on spurious emissions from fixed-satellite systems. (No specific impact until further work is done).

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7 App. 28	(IM CCIR 4/191)	<u>Calculation of the Maximum Power Density Averaged Over 4 kHz of an Angle-Modulated Carrier</u>

For use in Appendices 1A and 1B of the Radio Regulations, it is required to indicate the maximum power density per Hz as an average over the worst 4 kHz for carriers below 15 GHz. Given in this report is the method to calculate the power level in the worst 4 kHz (W/4 kHz), and dividing it by 4000 (Hz), the maximum power density per Hz can be obtained. It is presented for an FM carrier, a PM carrier modulated by multichannel telephony signal, and a PSK carrier.

New Report

IMPACT: Helps define "any 4 kHz band" as used in Article 7 and Appendix 28.

REFERENCEDOC. NO.TITLE

Art. 7

(IM CCIR
4/193)Criteria of Efficiency of Use of the
Geostationary-Satellite Orbit

This Report concerns not only the efficient use of bandwidth for a single transmission system, but also the efficient use of bandwidth when a number of potentially interfering common-frequency systems using the geostationary satellite orbit must also be taken into account. Paragraph 2 addresses itself to the problem of definitions of concepts previously used loosely such as criteria and efficiency. Paragraph 3 considers the concept of "measure" of utilization of the geostationary orbit and the frequency spectrum. Annexes I and II present in more detail two possible, specific measures and the associated methods of calculation.

New Report

IMPACT: (Art. 7)

None.

REFERENCEDOC. NO.TITLE

N/A

(IM CCIR
4/202)Consideration of Interference in a Digital
System in the Fixed-Satellite Service

In an attempt to identify certain possible sources of interference in a digital system in the Fixed-Satellite Service, a possible link interference allocation budget has been calculated based on certain assumptions and is presented.

New Report

IMPACT:

Systems design. Could lead to later recommendations of interference criteria for digital systems.

REF.

DOC. NO.

TITLE

Art. 1

204-3
(SG 4)

Terms and Definitions Relating to Space
Radiocommunications

Definitions include active and passive satellites, various orbital terms such as apogee, perigee, periastron, etc., and satellite types depending on orbital characteristics (e.g., synchronous satellite, attitude-stabilized satellite).

Report 204-3

IMPACT:

No effect on Article 1 of Radio Regulations.

REF.

DOC. NO.

TITLE

Art. 5

205-3
(SG 4)

Factors Affecting the Selection of Frequencies for Telecommunications with Space Stations

The purpose of this Report is to summarize the relationships between frequency and radio propagation and other technical factors which influence radio-communications in space, to provide a basis for the selection of frequencies for communication between the Earth and a space station. The propagation and environmental factors affecting communication with space stations and the impact of equipment technology are discussed.

Report 205-3

IMPACT: (Art. 5)

General information.

REF.

DOC. NO.

TITLE

Art. 7

206-3
(SG 4)

Technical Characteristics of Systems in
the Fixed-Satellite Service
General considerations relating to the
choice of orbit parameters

The various orbits proposed for use in the Fixed-Satellite Service are categorized from a technical point of view and those types that seem most desirable for operational use are discussed.

Report 206-3

IMPACT: (Art. 7)

No bearing on Radio Regulations.

REF.

DOC. NO.

TITLE

N/A

207-3
(SG 4)

Active Communication-Satellite Systems
Characteristics of experimental and
operational systems

This Report contains references to the experimental communication satellites launched prior to January 1965 and more detailed information on satellite systems initiated subsequently. The systems described include INTELSAT, MOLNIYA, ORBITA, TELESAT and the Applications Technology Satellite Project (ATS).

Report 207-3

IMPACT:

Information only, no bearing on Radio Regulations.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	208-3 (Rev. 76) (SG 4)	<u>Systems in the Fixed-Satellite Service for Frequency-Division Multiplex Telephony and Television</u> <u>Form of the hypothetical reference circuit and allowable noise standard; video bandwidth and sound channel for television</u>

A hypothetical reference circuit is presented with the literary references for others as well as allowable noise standards for each circuit. Annex I contains the overall noise characteristics of earth station receiving systems. Annex II contains some results of studies conducted for a specific example of this kind of system.

Report 208-3

IMPACT:	No direct impact. Could lead to later higher noise allocations.
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REF.

DOC. NO.

TITLE

N/A

211-3
(SG 4)

Active Communication Satellite Systems
A comparative study of possible methods
of modulation and multiple access (for
multi-channel telephony)

This Report has considered the advantages and disadvantages of several modulation methods suitable for systems in the Fixed-Satellite Service. An available bandwidth of 40 MHz for the space station repeater has been considered throughout. The various modulation techniques are compared on the basis of the communication capacity of the system (measured in telephone channels) vs. the available ratio of carrier power, at the input of the earth-station receiver, to the receiving system noise temperature. The degradation of the communication capacity inherent to the multiple-access mode of operation is discussed and it is found to be severe when frequency modulation and a great number of carriers is considered. It has been necessary to make a number of assumptions, some of which require verification.

Report 211-3

IMPACT:

No bearing on Radio Regulations.

REF.

DOC. NO.

TITLE

N/A

212-3
(SG 4)

Systems in the Fixed-Satellite Service
for Frequency-Division Multiplex Telephony
and Television
Use of pre-emphasis in frequency-modulation
systems

The advantages to the use of pre-emphasis in frequency modulation systems for telephony and television are listed and discussed. Three actual system examples with specific values are presented.

Report 212-3

IMPACT:

No bearing on Radio Regulations.

REF.

DOC. NO.

TITLE

N/A

213-3
(SG 4)

Factors Affecting Multiple Access in
Systems in the Fixed-Satellite Service
Methods of modulation, multiplexing,
orbital parameters and earth-station
sensitivity

The Report presents the many considerations in the design of multiple-access systems such as the numerous satellite orbits, modulation and multiplexing methods, methods of gaining access, etc., between which to choose (each with its advantages and limitations). A trade-off between these factors will influence the final selection of techniques to be employed.

Report 213-3

IMPACT:

No bearing on Radio Regulations.

REF.

DOC. NO.

TITLE

N/A

214-2
(Rev. 76)
(SG 4)

Systems in the Fixed-Satellite Service
The effects of Doppler frequency shifts
and switching discontinuities

In the Fixed-Satellite Service system, the received signal will be subject to Doppler frequency-shifts due to the relative velocities between satellite and earth stations, and discontinuities of transmission delay and of Doppler shift due respectively to the difference in the lengths of the radio paths and in the different relative velocities, on switching from one satellite to another. This Report considers the probable magnitude of these phenomena and their effect on various types of communication signal.

Revision of Report 214-2

IMPACT:

No bearing on Radio Regulations.

REF.

DOC. NO.

TITLE

N/A

352-2 (Rev. 76)
(SG 4)

Fixed-Satellite Service Systems for
Telephony and/or Television
Hypothetical reference circuits for
telephony and television in the fixed-
satellite service

Certain specifications are recommended for defining the hypothetical reference circuit for fixed-satellite systems such as: it should consist of one earth-satellite-earth link and links between the earth stations and associated switching centers should not be included.

The Revision lengthens the title.

Revision of
Recommendation 352-2

IMPACT:

No direct bearing on Radio Regulations.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	353-2 (Rev. 76) (SG 4)	<u>Systems in the Fixed-Satellite Service for Frequency-Division Multiplex Telephony Allowable noise power in the hypothetical reference circuit for frequency-division multiplex telephony in the fixed-satellite service</u>

Provisional values of noise power not to be exceeded in any telephone channel in the hypothetical reference circuit of Recommendation 352-2 are recommended.

The Revision makes a minor change to the title and adds notes referring to present administration procedures regarding noise power values and performance objectives.

Revision of
Recommendation 353-2

IMPACT:

No direct bearing on Radio Regulations. Interference noise is just one part; see Recommendations 466-1 and 356-3.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	354-2 (Rev. 76) (SG 4)	<u>Systems in the Fixed-Satellite Service</u> <u>Carrying Television</u> <u>Video bandwidth and permissible noise</u> <u>level in the hypothetical reference circuit</u> <u>for the fixed-satellite service</u>

It is recommended that the nominal upper limit of the video bandwidth should be compatible with the necessary bandwidth for the television system(s) to be transmitted and that the signal-to-noise ratios for continuous random noise at the end of the hypothetical reference circuit (of Recommendation 352-2) should provisionally be equal to the ratios recommended for the 2500 km terrestrial hypothetical reference circuit (Recommendations 421-3 and 451-2) for the appropriate TV standard.

The Revision makes a minor change to the title.

Revision of
Recommendation 354-2

IMPACT:

No direct bearing on Radio Regulations. Interference noise is just one part, see Recommendation 483.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	382-2 (Rev. 76) (IM CCIR 4/187)	<u>Determination of Coordination Area</u> Report 382-2 describes a procedure for determining the coordination area around an earth station transmitter or receiver in frequency bands between 1 and 40 GHz shared between space and terrestrial radio communication services.

The revision replaces Annexes II and III on basic transmission loss and mixed path coordination distances, respectively, by a modified version of the latter original annex.

Revision of Report 382-2

IMPACT: (Appendix 28) Simplifies modes by moving boundaries out to the coast.

REF.

DOC. NO.

TITLE

N/A

383-2
(SG 4)

Systems in the Fixed-Satellite Service
The effects of transmission delay

This Report discusses the magnitude of transmission delay, due to propagation time of the radio path, with various orbits. The effect on various types of communication signals is also shown.

Report 383-2

IMPACT:

No bearing on Radio Regulations.

REF.

DOC. NO.

TITLE

N/A

384-2
(SG 4)

Frequency Sharing Between Radiocommunication Satellite Systems and Terrestrial Radio Relay Systems
Energy dispersal in radiocommunication-satellite systems

In this Report, the results of some theoretical and experimental studies of energy-dispersal techniques, separately applicable to analog frequency-modulation and to digital radiocommunication-satellite systems are reported and suggestions for further experimental work are made.

Report 384-2

IMPACT:

No direct bearing on Radio Regulations, but discusses ways to reduce peak PFD's in operating systems.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VII, §20, 470E	385-1 (SG 4)	<u>Feasibility of Frequency Sharing Between Systems in the Fixed-Satellite Service and Terrestrial Radio Services</u> <u>Criteria for the selection of sites for earth stations in the fixed-satellite service</u>
		<p>This Report, as stated in the introduction, is intended to provide guidance to Administrations when selecting sites for earth stations in the Fixed-Satellite Service. Interference factors such as aircraft and precipitation are given and siting precautions are listed, as well as geographic, logistic and safety factors.</p> <p>Report 385-1</p>
IMPACT:		General information. No impact on Radio Regulations.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	388-2 (Rev. 76) (IM CCIR 4/188)	<u>Methods for Determining Interference in Terrestrial Radio Relay Systems and Systems in the Fixed-Satellite Service</u>

Report 388-2 presents an analysis and interference results for the two systems for various modulation combinations.

The revision accomplishes the same thing but with different equations, parameters and text.

Revision of Report 388-2

IMPACT: (Appendix 28) No direct impact; Determination of interference taking into account modulation techniques.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	390-2 (Rev. 76) (IM CCIR 4/173)	<u>Earth Station Antennae for the Fixed-Satellite Service</u> The characteristics of the Fixed-Satellite Service earth station antennae are described including mechanical and structural aspects such as surface accuracy of reflectors and performance using a figure of merit (G/T). Annex I consists of radiation characteristics of earth station antennae outside the main beam. Annex II is the noise temperature contributions due to extraterrestrial sources and Annex III is a measurement of the ratio G/T with the aid of radio stars. The revision is a new annex (Annex IV) on the safety aspects of radio frequency radiation from fixed earth station antenna systems. It provides information from which the maximum PFD's to be expected from an earth station antenna system using paraboloidal-type antennae may be calculated with respect to the power radiated at the antennna feed. Revision of Report 390-2
IMPACT:	(General, Radiation Hazards)	Annex IV shows 10 mw distance from antenna under various constraints. If U. S. wishes to add radiation hazards to the Radio Regulations this is one input. Another is in Study Group 2, AD/2 (IM 2/116).

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	391-2 (Rev. 76) (IM CCIR 4/163)	<u>Radiation Diagrams of Antennae for Earth Stations in the Fixed Satellite Service for Use in Interference Studies</u>

A reference radiation diagram formula is given in Report 391-2 to be used for coordination and mutual interference studies between typical earth stations ($D/\lambda > 100$) and either terrestrial stations or space stations. Some data are provided but studies are needed for antennae with $D/\lambda < 100$ and antenna patterns are welcome from administrations containing the information stated.

The revision updates the text regarding current information on the pertinent antenna patterns and figures are added of statistical data from a large earth station antenna at 4 and 6 GHz and 10 and 80 GHz.

Revision of Report 391-2

IMPACT: No impact on Radio Regulations in general.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7	446-1 (Rev. 76) (SG 4)	<u>Carrier Energy Dispersal in Systems in the Fixed-Satellite Service</u>

Considering that energy dispersal techniques are being regularly and successfully employed in some Fixed-Satellite Service systems, systems in the Fixed-Satellite Service employing angle modulation by analogue signals and those employing digital modulation should use carrier energy dispersal techniques when technically feasible or as far as is practicable.

The Revision takes "in Systems" out of the title and corrects two reference numbers to indicate '76 revisions.

Revision of
Recommendation 446-1

IMPACT: (Art. 7)

No bearing on Radio Regulations; method for minimizing PFD's.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5, Art. 7, Section VIII	451-1 (Rev. 76) (IM CCIR 4/185)	<u>Factors Affecting the System Design and the Selection of Frequencies for Inter- Satellite Links of the Fixed-Satellite Service</u>
		In Report 451-1 frequencies are chosen for radio links between spacecraft for three configurations. The simplest uses omnidirectional antennae on both spacecraft. The second has directional antennae on one of the spacecraft and the most advanced has directional antennae on both.
		The revision consists of completely rewritten text which considers, in broad terms, the concepts involved in the development of inter-satellite links and the technical requirements of inter-satellite link operation. The benefits of the inter-satellite link are given as well as design considerations and discussion on the choice of frequencies. An annex discusses geometry and pointing errors for non-tracking antennae in an inter-satellite link.
		Revision of Report 451-1
IMPACT:	(Article 5)	Technical information on inter-satellite links; Lower part of Band 10 allocated for short-hop).
	(Article 7, Section VIII)	U. S. Proposal may make these shared bands (with Fixed Service).

REFERENCEDOC. NO.TITLE

Art. 7,
Section IX
App. 29

453-1
(Rev. 76)
(IM CCIR
4/179)

Technical Factors Influencing the Ef-
ficiency of Use of the Geostationary Satellite
Orbit by Radiocommunication Satellites
Sharing the Same Frequency Bands General
Summary

Report 453-1 is a summary of the technical factors including operational which govern the efficient utilization of the geostationary-satellite orbit such as the minimum separation required to avoid interference between satellites employing common frequencies, modulation characteristics, stationkeeping, etc.

The revision adds a lot of text on such subjects as modulation conversion transponders single entry interference allowance, the use of multiple frequency-band-pairs in satellites, the effect of propagation conditions, etc.

Revision of Report 453-1

IMPACT: (Article 7)

If adopted as a Recommendation it would add several paragraphs to Article 7, Section IX.

(App. 29)

Provides new information for determining interference between satellite networks.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 29	454-1 (Rev. 76) (SG 4)	<u>Use of the Geostationary-Satellite Orbit Method of calculation to determine whether two geostationary-satellite systems require coordination</u>

A method to determine the necessity of coordinating two geostationary satellite systems is described in this Report. It follows Appendix 29 almost exactly and is likewise based on the concept that the noise temperature of the system receiving interference undergoes an apparent increase due to the effect of the interference and can therefore be used irrespective of the modulation characteristics of the satellite networks concerned and the precise frequencies employed.

In the revision the assumptions made for the calculations are specified in the text of the introduction to Section 2. θ is defined more accurately and awkward wording is corrected.

Revision of Report 454-1

IMPACT: (App. 29) In line with approach in Appendix 29.

REF.DOC. NO.TITLE

Art. 7,
Section IX

455-1
(SG 4)

Frequency Sharing Between Networks of
The Fixed-Satellite Service

This Report is a study on the feasibility of sharing by different satellite networks of the Fixed-Satellite Service. Certain conclusions are drawn such as the actual spacing required for geostationary satellites depends on system parameters such as e.i.r.p., size of earth station antennae, etc., and presently cannot be defined in general terms. Frequency sharing between geostationary networks and moving satellites is feasible if one of the satellites is turned off when sufficient angular separation is not provided.

Report 455-1

IMPACT: (Art. 7,
Section IX)

No apparent impact. Interim Meeting established plans to review and amend Report 455 to deal more specifically with coordination between two satellite networks.

REF.

DOC. NO.

TITLE

N/A

464
(SG 4)

Systems in the Fixed-Satellite Service
for Multiplex Telephony
Pre-emphasis characteristics for frequency-
modulation systems

The expression for the preferred pre-emphasis characteristic is given and it is recommended that systems with capacities of 12 or more telephone channels should use the same normalized pre-emphasis characteristic. Capabilities of less than 12 channels require further study.

Recommendation 464

IMPACT:

No bearing on Radio Regulations.

REF.

DOC. NO.

TITLE

App. 28

465-1
(SG 4)

Reference Earth Station Radiation Pattern
for Use in Coordination and Interference
Assessment in the Frequency Range from
2 to about 10 GHz

In the absence of information concerning the antenna radiation pattern for an earth station, a reference radiation pattern is recommended for a frequency range of 2 to 10 GHz and $D/\lambda > 100$.

Recommendation 465-1

IMPACT:

No impact. Radiation pattern recommended is in Appendix 28.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 29	466-1 (Rev. 76) (SG 4)	<u>Systems in the Fixed-Satellite Service for Telephony Using Frequency-Division Multiplex</u> <u>Maximum permissible levels of interference in a telephone channel of a geostationary satellite network in the fixed satellite service employing frequency modulation caused by other networks of this service</u>

A certain maximum interference noise power at a point of zero relative level in any telephone channel of a hypothetical reference circuit of a network in the Fixed-Satellite Service is recommended for different geostationary satellite networks in the same frequency bands, below 10 GHz. The revision was minor.

Revision of Recommendation 466-1

IMPACT: (App. 29) Interference level used in Appendix 29.

REF.

DOC. NO.

TITLE

N/A

481
(Rev. 76)
(SG 4)

Systems in the Fixed-Satellite Service for
Telephony Using Frequency-Division Multi-
plex
Measurement of noise in actual traffic

Certain recommendations are made for the measurement of noise occurring in links in the Fixed-Satellite Service while actual traffic is being carried regarding where to measure the noise, at what frequencies, and with what filter attenuation.

Revision of Recommen-
dation 481

IMPACT: No bearing on Radio Regulations

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	482 (SG 4)	<u>Systems Using Frequency-Division Multiplex in the Fixed-Satellite Service for Telephony</u> <u>Measurement of performance by means of a signal of a uniform spectrum</u>

This document recommends that the performance of frequency-division multiplex satellite links in the Fixed-Satellite Service should be measured by means of a signal with a continuous uniform spectrum in the frequency band used for the telephone channels. Various characteristics regarding the test signal and set-up (such as filter discrimination values) are also recommended.

Recommendation 482

IMPACT: No bearing on Radio Regulations.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section IX, App. 29	483(Rev. 76) (SG 4)	<u>Systems for Television Using Frequency Modulation in the Fixed-Satellite Service</u> <u>Maximum permissible level of interference in a television channel of a geostationary satellite network in the fixed satellite service employing frequency modulation, caused by other networks of this service</u>

It is recommended that different geostationary satellite networks in the Fixed-Satellite Service operating in the same frequency bands be designed in such a manner that the interference noise power in a hypothetical reference circuit for television of a network caused by the aggregate of other networks earth and space station transmitters should not exceed one-tenth of the permissible video noise in the circuit for more than 1% of any month. There are additional notes regarding special cases.

The revision was minor.

Revision of Recommendation 483

IMPACT:	(Art. 7, Section IX, App. 29)	Provides interference protection for a TV channel using FM from other fixed satellite networks.
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<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section IX	484 (Rev. 76) (IM CCIR 4/165)	<u>Stationkeeping of Geostationary Satellites Using Frequency Bands Allocated to the Fixed-Satellite Service</u>

Space stations on geostationary satellite using frequencies allocated to the Fixed-Satellite Service should be capable of maintaining their positions within $\pm 1^\circ$ of the longitude of their normal positions and should do so unless no unacceptable level of interference occurs to other satellite networks which comply with the same position limits. Efforts should be made to attain the capability of maintaining longitude within $\pm 0.5^\circ$.

The revision states that satellites shall maintain their longitudinal position within $\pm 0.5^\circ$ except where there are no interference creating problems to other networks using the same limits.

Revision of Recommendation 484

IMPACT: (Article 7,
Section IX)

Revise Radio Regulation 470VC

REFERENCEDOC. NO.TITLE

Art. 5

552 (Rev. 76)
(IM CCIR
4/192)Use of Frequency Bands above 10 GHz in
the Fixed-Satellite Service

Report 552 makes a preliminary examination of some of the technical factors which should be considered in the design of systems of the Fixed-Satellite Service which are intended for use in frequency bands above about 10 GHz. The factors considered are earth station arrangements to avoid the effects of precipitation, frequency sharing with terrestrial systems, and a system design method.

The revision clarifies and updates text and adds four new annexes on respectively: a variable information transmission rate system using error correcting codes, a calculation of the power characteristics of satellite links in bands above 10 GHz, factors relating to the choice of signal transmission methods in the same bands, and earth station characteristics in the 14/11 GHz band.

Revision of Report 552

IMPACT: System design; covers bands up to 30 GHz.

REF.

DOC. NO.

TITLE

N/A

553
(SG 4)

Fixed-Satellite Service Operation and
Maintenance of Earth Stations

This Report discusses the technical facilities required to test the performance of a Fixed-Satellite Service system. Recommendations are made regarding the purchase of equipment.

Report 553

IMPACT:

No bearing.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Sections VII App. 28, App. 29	554 (Rev. 76) (IM CCIR 4/142)	<u>The Use of a Transportable Earth Station With a Small Antenna for Relief Operation in the Event of Natural Disasters and Similar Emergencies</u>
		Report 554 discusses a presently feasible configuration of an air-transportable earth station in the 4 and 6 GHz bands and its preferred system characteristics, for use with a geostationary satellite system in the Fixed-Satellite Service. The discussion covers some possible types of modulation, required bandwidth, satellite e.i.r.p., earth station e.i.r.p., low noise receiver characteristics, high power amplifier requirements, as well as antenna system parameters.
		The revision replaces the table of transmission system parameters in 6/4 GHz band by one containing different values and indicates in added text that transmission quality of each of the systems was subjective and not necessarily similar.
		Revision of Report 554
IMPACT:	(Article 7/ VII Appendix 28, Appendix 29)	Parameters of described system may not conform to existing sharing constraints. Existing coordination procedures would not be feasible for this type of situation.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section IX, App. 29	555 (Rev. 76) (IM CCIR 4/157)	<u>Polarization Discrimination by Means of Circular and Linear Polarization</u> <p>Report 555 presents an analysis of the use of orthogonal polarization as an effective way of increasing the capacity of the geostationary orbit. The factors considered include the characteristics of polarizers, cross-polarization discrimination obtainable in different parts of antenna beams and in different frequencies within the operating bands, the depolarizing effects experienced in the atmosphere and ionosphere, the stability of satellite orientation and the implementation of polarization tracking.</p> <p>The revision contains updated information on polarizers, antenna systems, precipitation effects on propagation, etc.</p> <p style="text-align: right;">Revision of Report 555</p>
IMPACT:	(Appendix 29)	Suggests including polarization to spacing of satellites in orbit.
	(Article 7, Section IX)	<p>Factors increasing the utility of the geostationary orbit should be included in Article 7, Section IX.</p> <p>The technical basis for a definite decision is not yet available.</p>

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section IX	556 (Rev. 76) (SG 4)	<u>Systems in the Fixed-Satellite Service</u> <u>Factors affecting the station-keeping</u> <u>of satellites in the geostationary-satellite</u> <u>orbit</u>

Efficiency in utilization of the geostationary orbit could be increased by more effective control on satellite position especially movement of the satellite in longitude. The four causes of this drifting motion are described and mention is made of present capability.

The revision makes two minor changes to text.

Revision of Report 556

IMPACT:	(Art. 7, Section IX)	No direct impact but see Recommendation 484 (Rev. 76).
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<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5 Art. 7, Section VIII, IX	557 (SG 4)	<u>Systems in the Fixed-Satellite Service</u> <u>The use of frequency bands allocated to</u> <u>the fixed-satellite service for both</u> <u>the up-path and down-path of geostationary-</u> <u>satellite systems</u>

This Report examines the possibility of reversing the assignment of the up and down path bands in certain satellites which are between two satellites under the present regulation of path frequencies. It is concluded that the use of frequency bands in both up and down path directions may lead to improved efficiency of orbit utilization and that it might be of particular value in bands which are allocated exclusively for space radio-communication services. However, further study of the problems involved is necessary.

Report 557

IMPACT: (Art. 5)	If Report's premises followed, allocations of fixed-satellite bands would be made bi-directional.
(Art. 7, Sections VIII, IX)	Additional PFD restrictions might be needed to protect Fixed-Service. New PFD's might be needed to protect antipodal fixed-satellites. Report indicates that further study is necessary.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 29, Art. 7, Section IX	558 (Rev. 76) (IM CCIR 4/204)	<u>Antenna Radiation Patterns of Space Sta-</u> <u>tions in the Fixed-Satellite Service</u> <p>Report 558 is a preliminary examination of the problems of defining a reference radiation pattern for use in the Appendix 29 procedures and a tentative pattern is offered for further study.</p> <p>The revision makes the title more descriptive of the contents of the document, Annex II (sidelobe characteristics of high gain satellite antennae) becomes Annex III and a new Annex II is added on beam shaping. New text and accompanying figures are added on both polarizations of satellite antennae.</p> <p style="text-align: right;">Revision of Report 558</p>
IMPACT:	(Appendix 29)	Report would add more parameters to Appendix 29 model.
	(Article 7, Section IX)	Potential for added regulations to Article 7, Section IX regarding geostationary satellite-to-satellite sharing.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section IX	559 (SG 4)	<u>The Effect of Modulation on the Efficiency of Use of the Geostationary Satellite Orbit</u>

The satellite and earth station power requirements and the interference immunity of a signal are affected by the ratios B/f_m , the bandwidth required per unit of information bandwidth and, B/r , the bandwidth required per bit rate. These ratios are therefore parameters affecting the efficiency with which the orbit is used. Two specific cases are analyzed in this Report both involving homogeneous sets of satellites in orbit, one using FDM/FM and the other PSK transmissions.

Report 559

IMPACT: (Art. 7,
Section IX)

Increase in B/f_m and B/r ratios reduces minimum acceptable C/I value. Could result in some paragraphs in Section IX dealing with approaches to increased use of fixed-satellite bands (conclusions on impact similar to that in Report 453-1 (Rev. 76)).

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section IX, App. 29	560 (SG 4)	<u>Sharing Criteria for the Protection of Space Stations in the Fixed-Satellite Service Receiving in the Band 14.0-14.4 GHz</u>

Study Programme 2M/4 requires the study of the criteria for frequency sharing between the Fixed-Satellite Service (earth-to-space) and the radionavigation and radionavigation-satellite services at frequencies of the order of 14 GHz. This Report deals with those aspects concerning interference to geostationary space stations of the Fixed-Satellite Service and derives provisional values for the limits to provide sufficient protection.

Report 560

IMPACT:	(App. 29) (Art. 7 Section IX)	Provides PFD limits at geostationary altitude from ground transmitter and other geostationary satellites from 14.0 - 14.4 GHz.
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<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section IX, App. 29 Art.5	561 (Rev. 76) (IM CCIR 4/158)	<u>Frequency Band Sharing at about 12 GHz Between Geostationary Satellites of the Fixed-Satellite and Broadcasting-Satellite Services</u>
		Report 561 is concerned with the efficient utilization of the spectrum and geostationary orbit, and the interference problems between the Fixed-Satellite and Broadcasting-Satellite Services. Suggestions such as methods for frequency reuse in broadcasting-satellite up-paths, and clustering of like satellites are made.
		The revision updates the text and studies.
		Revision of Report 561
IMPACT:	(Appendix 29)	Suggests including polarization to spacing of satellites in orbit.
	(Article 7, Section IX)	Factors increasing the utility of the geostationary orbit should be included in Article 7, Section IX.
		If the technical information available warrants a recommendation this would add paragraphs to Article 7, Section IX and the calculation technique in Appendix 29.
	(Art. 5)	This would add fixed satellite earth-to-space to Regions 2 and 3, 10.95-11.2 GHz.

REF.

DOC. NO.

TITLE

App. 28

AA/5
(IM CCIR
5/124)

Calculation of Free-Space Attenuation

Methods are recommended for the calculation of attenuation in free space. The methods are contained in an annex listed as certain relevant formulae with nomograms for rough graphical calculations.

New Recommendation

IMPACT:

No direct bearing.

REF.

DOC. NO.

TITLE

App. 28

AC/5
(IM CCIR
5/122)

Propagation by Diffraction

The information contained in draft Report AG/5 is recommended for the calculation of field strengths over diffraction paths.

New Recommendation

IMPACT:

No direct bearing. Basic data on diffraction calculations.

REF.

DOC. NO.

TITLE

App. 28

AG/5

Propagation by Diffraction

General methods for estimating path attenuation due to earth diffraction are presented.

New Report

IMPACT:

No direct bearing. Basic data for Appendix 28.

REF.

DOC. NO.

TITLE

App. 28

AI/5

Propagation Data for the Evaluation of
Coordination Distance in the Frequency
Range 1-40 GHz

This Report is an Appendix 28 type procedure describing a method for determining coordination distance for an earth station in a space telecommunication service.

Report

IMPACT:

Direct to Appendix 28. Combines with Recommendation 452 and 382. Proposes new definitions for zones. Deletes mode (b).

REF.

DOC. NO.

TITLE

N/A

227-1
(S.G. 5)

General Methods of Measuring the Field
Strength and Related Parameters

This Report is concerned with general methods of measuring the field strength or other related parameters, for instance the power flux density, the power available from the receiving antenna or the radiated power.

Report 227-1

IMPACT:

No direct bearing on Radio Regulations.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28, Art. 9	233-3 (Rev. 76) (IM CCIR 5/95)	<u>Influence of the Non-Ionized Atmosphere on Wave Propagation Ground-Ground Propagation</u> Report 233-3 consists of a study of ground-ground links and the effects of atmosphere on propagation for many services. Consideration is given to phenomena common to all types of links (e.g., refraction) and reference is made to more specialized reports for treatment of a question which concerns a particular service. Certain radio meteorological parameters are also discussed. The revision removes references throughout the text and adds text to indicate that charts of ΔN are based on land-station data, since sea-station data was not available. Other additional text updates material on water vapor absorption, attenuation due to rain, and prediction methods of terrestrial link attenuation. Appropriate figures and references are added. Revision of Report 233-3
IMPACT:	(App. 28, Art. 9)	No direct impact, contributes information for the evaluation of the coordination procedure (especially regarding the modes and the treatment of the propagation dependent on atmospheric conditions).

REFERENCEDOC. NO.TITLE

Art. 5

234-3 (Rev. 76) Influence of the Non-Ionized Atmosphere
(IM CCIR on Wave Propagation Earth-Space
5/109) Propagation

Report 234-3 summarizes the main factors of atmospheric attenuation, including the dominant factors causing attenuation in clear sky conditions, attenuation due to precipitation, and refraction and its effects, with special reference to earth-space paths.

The revision removes or replaces references in text and adds text regarding variations in apparent position of a space station due to fluctuations in the refractive index, propagation delay and its variance, vertical path attenuation and oxygen absorption, sky noise temperature and propagation delay due to precipitation. Figures and references are added accordingly.

Revision of Report 234-3

IMPACT: (Art. 5)

Indirect effect (considers propagation of frequencies above 1 GHz). Provides technical support for earth-to-space transmission frequency allocation preferences.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	241-2 (S.G. 5)	<p><u>Propagation Data Required in Connection with the Prediction of Performance of Terrestrial Telecommunications Systems, and in Connection with the Determination of Interference Over Terrestrial Paths</u> <u>Collection of data</u></p> <p>Study Programmes 5A-2/5, 5B-1/5 and 5D-2/5 urge that propagation data over line-of-sight and trans-horizon paths be collected with a view to enabling Study Group 5 to reassess its existing methods for predicting transmission loss and to evolve new prediction methods. This Report invites information especially in certain listed areas that are scarce.</p> <p>Report 241-2</p>
IMPACT:		No direct bearing on Radio Regulations.

REF.DOC. NO.TITLE

Art. 5
Art. 7-IX

336-1
(S.G. 5)

Reception on the Moon

The area of the moon designated the radio quiet zone is defined as well as the criteria for deciding the size of the shielded cap and the effect of diffraction.

Report 336-1

IMPACT: (Art. 5
Art. 7-IX)

No direct bearing, but can be used as basis for determining radio-quiet zone on moon.

REFERENCEDOC. NO.TITLE

App. 28,
Art. 9

369-1
(Rev. 76)
(IM CCIR
5/93)

Reference Atmosphere for Refraction

Considering that the dependence of the refractive index n at the height h is well expressed by $n(h) = 1 + a \cdot \exp(-bh)$ where a and b are statistical climate-dependent constants, a basic reference atmosphere should be defined by $n(h) = 1 + 289 \times 10^{-6} \cdot \exp(-0.136h)$.

The revision rewords the recommendation slightly and changes the title from "Definition of a Basic Reference Atmosphere" to the above.

Revision of Recommendation 369-1

IMPACT: (App. 28,
Art. 9)

No direct impact, will eventually effect propagation curves in the procedure.

REFERENCEDOC. NO.TITLE

App. 28,
Art. 5,
Art. 9

426-1
(Rev. 76)
(IM CCIR
5/102)

Methods for Predicting Radio Noise and
the Attenuation and Refraction of Radio
Waves in Relation to Space Telecommunica-
tion Systems
Collection of data

In Report 426-1 administrations are urged to undertake long-term radio measurements, particularly at frequencies above 10 GHz and, if possible, associated rainfall measurements to be used in the development of methods for predicting radio noise and attenuation and refraction of radio waves in relation to space telecommunication systems and to summarize their experimental data in a format provided.

The revision rewords the specific measurements asked for to include indirect measurements of radar-derived attenuation.

Revision of Report
426-1

IMPACT: (App. 28,
Art. 9)

(Art. 5)

No direct impact. The result of the request will contribute information for evaluation of the coordination procedure, and contribute information for allocation decisions above 10 GHz.

REF.DOC. NO.TITLE

App. 28

452-1
(Rev. 76)
(IM CCIR
5/106)Propagation Data for the Evaluation of
Interference within and Between the Space
and Terrestrial Services and for the
Calculation of Coordination Distance

In order to calculate interference levels, it is necessary to have appropriate propagation data. Therefore, for frequencies higher than 600 MHz evaluation of interference levels should use the calculation methods in Report 569. Methods in Recommendation 370-2 and Reports 239-3 and 425-1 should be used otherwise. Comments regarding difficulties and improvements are invited. The revision changes Report 569 to draft Report 569 (Rev. 76) and for below 600 MHz the methods in draft Report 238-2 (Rev. 76) are recommended. In addition for frequencies between 1 and 40 GHz, the propagation calculation methods set out in draft Report AI/5 should be used.

Revision of Recommendation
452-1

IMPACT: (App. 28)

Recommends Report AI/5 be used for coordination calculations. (Recommendation 452, Reports AI/5 and 382 are all interrelated.)

REF.

DOC. NO.

TITLE

App. 28

453
(S.G. 5)

The Formula for the Radio Refractive Index

A formula is recommended to define the refractive index of an atmosphere based on absolute temperature, and atmospheric and water vapor pressure.

Recommendation 453

IMPACT:

No direct bearing on Radio Regulations.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28, Art. 9	563 (Rev. 76) (IM CCIR 5/94)	<u>Radiometeorological Data</u> Certain propagation calculations can only be made on the basis of radio meteorological data. Some such data is given in Report 563 and is presented as world charts of atmospheric radio refractive index at the earth's surface, the change over the first kilometer and the gradient near the surface; models of the variation of refractive index with height and rainfall statistics. The revision corrects references and adds text on rainfall characteristics and vertical variation of reflectivity.

Revision of Report 563

IMPACT: (App. 28, Art. 9)	No direct impact, contributes updated information valuable to the revision of the coordination procedure.
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<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	564 (Rev. 76) (IM CCIR 5/120)	<p><u>Propagation Data Required for Space Telecommunication Systems</u></p> <p>Report 564 deals with the aspects of propagation phenomena which may be of direct and immediate concern to the designer of space telecommunications systems. Included are discussions of regular refraction, wave front incoherence, scintillation and fading, absorption due to atmospheric gases and attenuation due to precipitation.</p> <p>The revision contains considerable additional text with updated information on all the above plus direct measurements using a satellite and radiometric measurements are presented.</p> <p>Revision of Report 564</p>
IMPACT:	(Art. 5)	No direct impact, provides information for the choice of space telecommunication frequencies as well as technical support for allocation requirements.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	565 (Rev. 76) (IM CCIR 5/128)	<u>Propagation Data for Broadcasting from Satellites at Frequencies Above 10 GHz</u> Report 565 gathers attenuation data in order to facilitate planning of broadcasting satellite systems. The revision replaces the values in a table of atmospheric attenuation at 11.5 GHz and adds reference to relatively recent measurements. Revision of Report 565
IMPACT:	(Art. 5)	No direct impact, technical support for broadcast satellite system allocation requirements.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	569 (Rev. 76) (S.G. 5)	<u>The Evaluation of Propagation Factors in Interference Problems at Frequencies Greater than about 0.6 GHz</u>
		<p>Report 569 offers methods for the quantitative assessment of interference arising due to frequency sharing with other systems at frequencies greater than 0.6 GHz. The statistical occurrence of interference varies according to different propagation mechanisms, each of which are subject to variations arising from the nature of the tropospheric propagation medium. The propagation mechanisms considered are line-of-sight, diffraction over isolated objects, diffraction over irregular terrain, and tropospheric forward scatter.</p> <p>The revision revises certain term definitions, adds references to other CCIR papers and clarifies text with added phrases.</p> <p style="text-align: right;">Revision of Report 569</p>
IMPACT:	(App. 28)	No direct bearing. Basic data for Appendix 28.

REFERENCEDOC. NO.TITLE

N/A

(IM CCIR
6/149)Ionospheric Factors Influencing Communica-
tion and Navigation Systems Involving
Spacecraft

Considering the need for information on the spatial and temporal variations of ionospheric electron concentration in different parts of the world and on the effects which these variations have on radio waves passing through the ionosphere, an IWP should be established to study all aspects of these phenomena which are relevant to the behavior of communication and navigation systems involving spacecraft. The member administrations are U. K., USA, Japan and France with the Chairman provided by the UK.

New Decision

IMPACT:

No impact. Will not come into being until next Final Meeting (1977). Will not have report until next Interim Meeting (after 1979 WARC).

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VII	258-2 (Rev. 76) (IM CCIR 6/122)	<u>Proposed Revision of Report 258-2</u> <u>Man-Made Radio Noise</u>
		Report 258-2 provides a figure with median values of man-made noise power from man-made sources for business, residential, rural and quiet rural areas.
		The revised version contains additional text discussing the variation of noise value between locations on the figure. In paragraph 3 residential area is referred to as "residential" rather than "urban" which is in the original. Text is also added to indicate that the United Kingdom has measured lower noise powers. A description of the method used to measure the noise intensity outside and in London is added with a table of values of noise measurements.
		Revision of Report 258-2
IMPACT:	(Article 7)	Of possible general interest in siting receiving stations but no actual impact to Article 7, VII.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	263-3 (Rev. 76) (IM CCIR 6-126)	<u>Ionospheric Effects Upon Earth-Space Radio Propagation</u> Report 263-3 describes the effects on a radio signal above 30 MHz penetrating the ionosphere. The effects include scintillation, absorption variation in the direction of arrival, propagation delay, frequency change and polarization. In addition to several editorial corrections, text is replaced by the revision regarding the zenith path values and scintillation intensity; diurnal variation of mid-latitude scintillation; auroral absorption from increases of electron concentration, polar-cap absorption, refraction effects and variations in the direction of arrival and radio wave group delay. The replacement text provides more useful and updated summaries of the topics. Text is also added or inserted on ionospheric fading margins and experiments with LES-6 and ATS-5 and ISIS 1 and 2 and signal statistics. A corrigendum makes several more editorial corrections. Revision of Report 263-3
IMPACT:	(Art. 5)	No direct impact. Report could be used as a technical basis for allocations where presence or absence of ionospheric effects are important.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	363-3 (Rev. 76) IM CCIR 7/71	<u>Comparison of Standard-Frequency and Time-Signal Emissions by Various Methods</u>

The various methods of time comparisons such as television pulses, portable clocks, the use of very long baseline radio interferometry, and satellites are described.

The recent revision adds considerable text containing updated information on the testing and utilization of each method.

Revision of Report 363-3

IMPACT: No direct bearing on Radio Regulations.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	518-1 (Rev. 76) (IM CCIR 7/59)	<p><u>Standard Frequency and Time Signal Dis-</u> <u>semination Via Satellites (Rev. of Report</u> <u>518)</u></p> <p>Report 518 reviews the present situa- tion of the utilization of satellites for the dissemination of standard frequencies and time signals, and lists the character- istics of one-way and two-way operations.</p> <p>The revision consists of an addition of text and references regarding the time transfer experiments performed by the National Bureau of Standards using NASA's ATS-3, the John Hopkins Applied Physics Lab using a Navy system, NBS and the Synchronous Meteorological Satellite System, and NASA and FAA use of ATS-1 for time experiments.</p> <p>Two annexes are added consisting of the equipment mechanization for the NASA- FAA-ATS-1 experiment and the radio- frequency terminal system characteristics for the same setup.</p> <p style="text-align: right;">Revision of Report 518-1</p>
IMPACT:		No impact. Report describes several systems using presently allocated bands.

REFERENCEDOC. NO.TITLE

Art. 7,
Section VIII

AB/8
(IM CCIR
8/116)

Systems in the Maritime Mobile Satellite
Service Hypothetical Telephone Reference
Circuit

The hypothetical telephone reference circuit in Rec. 352-2 for the Fixed Service using communication satellites may not satisfy the needs of the Maritime Mobile-Satellite Service.

Additionally, in a Maritime Mobile-Satellite Service system two hypothetical telephone reference channels are required because of the difference in technical characteristics between the two directions of transmission (ship-to-shore and vice-versa).

Several recommendations are made regarding the set up of the hypothetical telephone reference circuit.

New Recommendation

IMPACT: (Art. 7,
Section VIII)

No impact on Radio Regulations.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VIII	AJ/8 (IM CCIR 8/125)	<u>Quality Objectives for Communication Cir- cuits in the Maritime Mobile-Satellite Service</u>

This report covers various proposals for the quality objectives for telephone and telegraph channels which may be used within the Maritime Mobile-Satellite Service. These objectives relate to the performance that can be expected for a certain percentage of time within an area dependent upon satellite antenna beam patterns and shipborne antenna gains.

New Report

IMPACT: (Art. 7,
Section VIII) No direct impact.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VIII	AL/8 (IM CCIR 8/33)	<u>Methods for the Subjective Assessment of Speech Quality in the Maritime Mobile- Satellite Service</u>
		<p>The purpose of this Report is to point out possible methods that could be used both for listening-only and for bi-lateral conversational tests for the assessment of the performance of a telephone connection involving a maritime mobile satellite system. Included are descriptions of articulation tests and opinion scales.</p> <p>An addendum adds a paragraph to indicate that experiments have shown that PB word tests can be modified from standard procedures without significantly affecting accuracy and reliability.</p> <p>New Report</p>
IMPACT:	(Art. 7, Section VIII)	No impact.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VIII	AR/8 (IM CCIR 8/163)	<u>Interference and Noise Problems for Maritime Mobile-Satellite Systems Using Frequencies in the Region of 1.5 and 1.6 GHz</u>

Operational maritime mobile satellite systems will employ at least frequencies in the region of 1.5 and 1.6 GHz for the satellite-to-ship and ship-to-satellite links respectively. This Report gives results of a theoretical investigation of the potential interference to a maritime mobile satellite system from different sources and of the interference caused to other systems from the maritime mobile satellite systems at such frequencies. Results of practical electromagnetic (EM) noise measurements in harbours and onboard ships at sea are summarized. Finally, consideration is given to other sources of noise at these frequencies such as extra-terrestrial noise and receiver noise temperature.

New Report

IMPACT:	(Art. 7, Section VIII)	No direct impact, information for determination of PFD limits.
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REFERENCEDOC. NO.TITLE

Art. 7,
Section VIII

AS/8
(IM CCIR
8/152)

Satellite-to-Ship Link Margins at 1.5 GHz
for a Maritime Mobile-Satellite System

The various characteristics and factors which determine link margin requirements are described. Certain conclusions are drawn which indicate losses (long and short term) that should be allowed for when setting up link margins to insure reasonable performance of the maritime mobile satellite system.

New Report

IMPACT: (Art. 7,
Section VIII)

No impact, system design.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	216-2 (SG 8)	<u>Technical Characteristics of Systems Providing Communication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships</u> <u>Use of satellites for terrestrial radio-determination</u>

The four basic radiodetermination techniques are described with the important role that satellites can play in the process.

Report 216-2

IMPACT:

No impact, already Radionavigation-Satellite Service allocations exist, information only.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	361-2 (SG 8)	<u>Frequency Requirements of Radiodetermination-Satellite Systems</u>
		<p>Frequencies in Bands 8, 9, and 10 are technically suitable for the application of the technical principles to radio-determination by satellite. The use of narrowband systems is preferable as well as the utilization of radiodetermination frequencies for radiodetermination satellite systems telemetering signals. Further investigation of the possible systems must be conducted. Since atmospheric absorption due to water vapor and oxygen is significantly less in the region below 20 GHz and in a narrow region near 35 GHz, these are the preferred frequencies for use by radio-sextant radiodetermination systems.</p>

Recommendation 361-2

IMPACT: (Art. 5)	Include telemetry in radiolocation allocations in Bands 8, 9, and 10, although further experimentation is suggested into the possible systems.
No Impact	35 GHz and 10 and 20 GHz already contain radiolocation allocations so they are available to radio-sextant radiodetermination. Suggestions are made as to the utilization of various allocations (e.g., bands 8 and 9 for Doppler and time measurements) and it is indicated that use of narrow bands are preferable.

REF.

DOC. NO.

TITLE

Art. 5

394-1
(SG 8)

Feasibility of Frequency Sharing Between
the Radiodetermination Satellite Service
and the Terrestrial Services

The report discusses the considerations generally and decides that the feasibility of sharing will have to be determined on a case-by-case basis after recognition and analysis of the technological parameters of the satellite system, as well as the terrestrial system under consideration.

Report 394-1

IMPACT: (Art. 5)

No impact, already sharing in several cases.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Sections VII, VIII, & IX	496 (SG 8)	<u>Frequency Sharing Between the Fixed-Satellite Service and the Radionavigation-Satellite Services at Frequencies of the Order of 14 GHz</u> <u>Limits of interfering power flux density and power density to protect space station receivers in the fixed satellite service</u>

Earth-to-space transmissions of the Fixed-Satellite Service share the band 14-14.3 GHz with the Radionavigation Service, and share the band 14.3-14.4 GHz with the Radionavigation Satellite Service. Some radionavigation devices such as small ship radars have low powers but are numerous. In order to provide sufficient protection to space station receivers of the Fixed-Satellite Service, provisional PFD limits are suggested based on the geographical density of active Radionavigation Satellite Service transmitters per 1 MHz band. Further study is requested before the XIVth Plenary Assembly.

Recommendation 496

IMPACT:	(Art. 7, Sections VII, VIII, and/or IX)	PFD limits for radionavigation and radionavigation satellite transmitters at geostationary space station receiver for 14-14.3 bands subject to further study. Some sort of coordination required.
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<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	504-1 (SG 8)	<u>Technical Characteristics of Systems Providing Communication and/or Radio- determination Using Satellite Techniques for Aircraft and/or Ships</u> <u>Propagation, antennae and noise as factors affecting the choice of frequency for telecommunication between an aircraft/ship and a satellite</u>

This Report discusses the propagation, antenna and noise characteristics of the transmission path between satellite and aircraft in Bands 8 and 9, taking account of the aeronautical or maritime environment. Considerations of tropospheric and ionospheric attenuation indicate that an aeronautical or Maritime-Satellite Service which does not involve propagation across an auroral zone could operate in a frequency band lying between about 70 MHz at the lower end and between 10 and 20 GHz at the upper end. The required system power margins will be dominated at the lower frequencies by ionospheric effects and at the higher frequencies by clouds, gases, and precipitation in the lower atmosphere.

Report 504-1

IMPACT: (Art. 5)

No impact yet. Report states that "the use of higher frequencies could present practical antenna steering and installation difficulties; further studies required" especially prior to further allocation.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	511 (SG 8)	<u>Feasibility for Stations in the Aeronautical and Maritime Mobile Services to Share the Same Frequency Bands When Using Space Communication Techniques Preliminary operational and economic considerations</u>

The three possible sharing arrangements between aircraft and ships are described. They consist of use of common channels to conserve spectrum and equipment design, the use of common channels for common needs and the third is the use of exclusive channels for unique needs and the exclusive channel assignments. The Report concludes that the second alternative appears to be the most effective due to the large band requirements by both Services.

Report 511

IMPACT: (Art. 5)	<p>No impact.</p> <p>In itself not sufficient to suggest specific allocations, but contributes important technical considerations for the decision (one allocation presently exists at 14.3 GHz for radionavigation-satellite).</p>
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<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	513-1 (SG 8)	<u>Technical Characteristics of Systems Providing Communication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships</u> <u>Technical feasibility of systems employing space communication techniques jointly for communication and radiodetermination purposes in the VHF mobile communication bands</u>
		<p>This Report discusses some of the technical considerations affecting the feasibility of using the VHF aeronautical and maritime mobile communication bands jointly for communication and radiodetermination purposes using space techniques. Some of the conclusions drawn are that radiodetermination techniques that can use a voice channel have already been demonstrated experimentally in the VHF aeronautical mobile communication band with the ATS-1 and ATS-3 Application Technology Satellites. Carrier frequencies as low as 224.5 and 150 MHz are in use on an operational basis and have proved successful in providing very high accuracy position determination of fixed stations with the SECOR satellite system and of ships with the U. S. Doppler navigation satellite system and the use of two-carrier frequencies successfully reduces position error caused by the ionosphere.</p> <p style="text-align: right;">Report 513-1</p>
IMPACT:	(Art. 5)	<p>Technical support for UHF and VHF aeronautical and maritime mobile communication bands to include use of satellite aeronautical and maritime communication radiodetermination.</p>

REFERENCEDOC. NO.TITLE

Art. 5

591 (Rev. 76)
(IM CCIR
8/131)

Technical Characteristics of Systems Providing Communication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships
Noise as a factor affecting the choice of frequency for telecommunications between an aircraft/ship and a satellite

Report 591 contains brief descriptions of the various types of background radio noise which narrows the choice of optimum frequency bands. The '76 revision rearranges the order of the presented material and eliminates the large section of VHF experimental results and further theoretical predictions.

Revision of Report 591

IMPACT: (Art. 5)

No direct impact yet, technical support for frequency requirements at 1500 MHz rather than at VHF for aircraft/ship and satellite links; more study required.

REFERENCEDOC. NO.TITLE

Art. 5

592 (Rev. 76)
(IM CCIR
8/117)

Technical Characteristics of Systems Pro-
viding Communication and/or Radiodeter-
mination Using Satellite Techniques for
Aircraft and/or Ships
Some factors affecting the planning and
designing of a satellite system to be
used in the maritime mobile service

The purpose of Report 592 is to suggest certain technical characteristics of the systems which appear to be suitable for providing communication, including distress and safety and radiodetermination.

The revision replaces Section 3.2 which is concerned with the choice of frequencies for satellite-ground links. The replacement discusses specific frequencies and presents explanation and reasons for the choice.

Revision of Report 592

IMPACT: (Art. 5)

No direct impact.

REF.DOC. NO.TITLE

Art. 5

593
(SG 8)Feasibility of Sharing Between the Maritime
Mobile Satellite Service and the (Ter-
restrial) Maritime Mobile Service

The results of a preliminary theoretical study on the feasibility of frequency sharing between these two systems in the 150 MHz band are described in this Report. With present technology, sharing is feasible provided the ship in the satellite system maintains a minimum geographical separation from the coastal transmitter.

Report 593

IMPACT: (Art. 5)

Mobile (maritime mobile) allocations in Band 8 would be coallocated with the Maritime Mobile-Satellite Service. At present there are no Mobile-Satellite Service allocations in Band 8.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	594 (Rev. 76) (8/37, 8/121, 8/174, 8/186)	<u>Technical Characteristics of Systems Providing Communication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships</u> <u>Antennae for aircraft and ships</u>

Report 594 considers the major factors influencing the design of mobile vehicle antennae. In aircraft and ships, antennae with suitable characteristics have to be provided in unfavorable environments and sited to allow unobstructed and/or multipath-free visibility over the required arcs. Vehicle motion creates an increased antenna coverage requirement. Mechanical steering is infeasible for aircraft and only in the case of an ideal site is it feasible for ships.

Revision 8/37 and its corrigendums 8/121 and 8/186 replace the present Section 7 of Report 594 with a considerably more detailed description of ship antennae with a table summarizing the characteristics. Revision 8/174 adds texts in Section 5 regarding updated aircraft antennae information.

Revision of Report 594

IMPACT:

No bearing on Radio Regulations. Information only.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 5	595 (Rev. 76) (IM CCIR 8/118)	<u>Systems Providing Radiocommunication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships (Rev. Report 595)</u>

Report 595 summarizes operational functions in the Maritime and Aeronautical Satellite Services, and explores possibilities of sharing between these Services.

The revision adds § 3.3.3 which consists of operational and administrative message requirements.

The Report appears to have no direct effect on Article 5 except to clarify the operational needs of the Aeronautical and Maritime Services, which are currently under consideration by ICAO and IMCO.

Revision of Report 595

IMPACT: (Art. 5)

No direct impact. Eliminates the possibility of sharing for certain specific functional communications.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VIII, App. 4	(IM CCIR 9/125)	<u>Protection of Terrestrial Line-of-Sight Radio Relay Systems Against Interference from the Broadcast-Satellite Service in the Band 11.7-12.5 GHz</u>
<p>This report considers interference to the Fixed Service from the Broadcasting-Satellite Service and provides technical parameters for the Fixed Services in the 12 GHz band including provisional maximum permissible PFD's. Interference from broadcasting satellite spurious emissions in adjacent bands is also discussed.</p> <p style="text-align: center;">New Report</p>		
IMPACT:	(Art. 7, Section VIII)	Provides PFD values for Broadcasting-Satellite Service at 11.7-12.5 GHz to permit sharing with Fixed Service. (470NS, Rec. Spa 2-10).
	(App. 4)	Provides spurious emission values for broadcasting satellites at 11.7-12.5 GHz to protect services in adjacent bands. Figure can also apply to the 12.5-12.75 GHz band.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VIII	(IM CCIR 9/132)	<u>Radio Relay Systems for Telephony Systems using single sideband amplitude modulation (SSB) at microwave radio frequencies</u>

This report deals with the use of single sideband, suppressed carrier, am transmission for a high capacity FDM line-of-sight, radio relay system for telephony presently under development in the U. S. in the lower 6 GHz band. The conclusion is that an SSB system can be placed in an existing FM network and it can equally share a band with satellites in the Fixed Satellite Service using sharing criteria that were developed for low index FM systems.

New Report

IMPACT:	(Art. 7. Section VIII)	None, information only, indicates a SSB system can operate under existing FM system criteria.
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<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	(IM CCIR 9/179)	<u>Reference Radiation Patterns for Radio Relay System Antennae</u> <p>Report 614 presents reference radiation patterns for radio relay system antennae considered suitable for preliminary elimination studies.</p> <p>The revision reorganizes former sections but maintains the same antennae patterns. A section on reference patterns for frequency reuse problems in radio relay systems is added.</p> <p>Revision of Report 614</p>
IMPACT:	(App. 28)	None, information only, provides reference radiation patterns for radio relay system antennae.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Sections VII, VIII, App. 28	209-3 (SG 4,9)	<u>Frequency Sharing Between Systems in the Fixed-Satellite Service and Terrestrial Radio Services</u>

The Report presents sharing factors (power, transmission loss, etc.) and sharing methods between systems in the Fixed-Satellite Service and Terrestrial Radio Services. Two annexes elaborate on two of the methods for sharing.

Report 209-3

IMPACT:	(Art. 7, Sections VII, VIII, App. 28)	No direct impact, basic sharing techniques are presented.
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REF.DOC. NO.TITLE

Art. 7,
Sections
VII, VIII,
App. 28

355-2
(SG 4,9)

Frequency Sharing Between Systems in the
Fixed-Satellite Service and Terrestrial
Radio Services in the Same Frequency Bands

It is recommended that in sharing between line-of-sight analogue angle-modulated radio-relay systems and Fixed-Satellite Service systems, the noise in a telephone channel arising from mutual interference should be limited to a small amount relative to the total allowable noise in the appropriate hypothetical reference circuit (Recommendations 356-3, 357-2). The control of mutual interference between Fixed-Satellite Service space stations and line-of-sight radio relay systems should be through constraints applicable to the use of both to avoid the need for specific coordination procedures (Recommendations 358-2, 406-3); however, earth stations in the Fixed-Satellite Service and terrestrial radio stations sharing the same frequency should apply specific coordination procedures (Recommendation 359-3).

Recommendation 355-2

IMPACT: (Art. 7,
Sections VII,
VIII, App. 28)

Recommends that Recommendations 356-3, 357-2, 358-2, 359-2 and 406-3 be followed (see each of these).

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	356-3 (SG 4,9)	<u>Systems in the Fixed-Satellite Service and</u> <u>Line-of-Sight Radio Relay Systems Sharing</u> <u>the Same Frequency Bands</u> <u>Maximum allowable values of interference</u> <u>from terrestrial radio links in a telephone</u> <u>channel of a system in the fixed-satellite</u> <u>service employing frequency modulation</u>

Mutual interference between Fixed-Satellite Service systems and line-of-sight radio-relay systems would increase the noise in both. Both types of systems sharing the same frequency bands should be designed in such a manner that the interference noise power at a point of zero relative level in any telephone channel of a hypothetical reference circuit of a system in the Fixed-Satellite Service caused by the aggregate of the transmitters of radio-relay stations should not exceed certain stated powers.

Recommendation 356-3

IMPACT: (App. 28)

In Appendix 28 the Recommendations are followed for analog systems.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28	357-2 (SG 4,9)	<u>Systems in the Fixed-Satellite Service and Line of-Sight Radio-Relay Systems Sharing the Same Frequency Bands</u> <u>Maximum allowable values of interference in a telephone channel of an analogue angle-modulated radio-relay system</u>

Systems in the Fixed-Satellite Service and line-of-sight analogue angle-modulated radio-relay systems which share the same frequency bands, should be designed in such a manner that, in any telephone channel of 250 km hypothetical reference circuit for frequency-division multiplex, analogue angle-modulated radio-relay systems, the interference noise power at a point of zero relative level, caused by the aggregate of the emission of earth stations and space stations of the systems in the Fixed-Satellite Service, including associated telemetering, telecommand, and tracking transmitters should not exceed certain values stated.

Recommendation 357-2

IMPACT: (App. 28)

In Appendix 28 the Recommendations are followed for analog systems.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7 Section VIII	358-2 (SG 4,9)	<u>Systems in the Fixed-Satellite Service and Line-of-Sight Radio-Relay Systems Sharing the Same Frequency Bands Above 1 GHz Maximum allowable values of power flux density at the surface of the earth pro- duced by satellites in the fixed-satellite service</u>

So that emissions from satellites do not cause harmful interference to line-of-sight radio-relay systems, certain maximum PFD's are listed for given bands of frequency (and angles of arrival) between 1.7 and 23 GHz.

Recommendation 358-2

IMPACT: (Art. 7,
Section
VIII)

Section VIII follows the Recommendation in those bands where space-to-earth services share with equal rights with fixed or mobile service. Provides tentative PFD values where new allocation proposals would share space services with fixed and mobile.

REF.DOC. NO.TITLE

App. 28

359-3
(SG 4,9)Space and Terrestrial Radiocommunication
Systems Sharing the Same Frequency Bands
Determination of the coordination area

It is recommended that the parameters for determination of coordination area of a transmitting or receiving earth station be taken from Report 382-2 as well as the required characteristics and criteria for interference and the curves for transmission loss.

Recommendation 359-3

IMPACT: (App. 28)

Recommends that Report 382-2 be followed in determining coordination area. Report 382-2 is very similar to Appendix 28 with the exception of rearranging the text of Section 3 and adding instructions to the effect that if the main beam of the earth station antenna is elevated less than 12° for long periods of time, the antenna main beam gain reduced by the aperture-to-medium coupling loss from Report 238-2 is used instead of the gain towards the horizon (see Report 382-2 (Rev. 76)).

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, App. 28	386-2 (SG 4,9)	<u>Feasibility of Frequency Sharing Between</u> <u>Systems in the Fixed-Satellite Service</u> <u>and Systems in the Terrestrial Service</u> <u>Determination of the power in any 4 kHz</u> <u>band which may need to be radiated toward</u> <u>the horizon by the earth stations</u>
		<p>The 4 kHz bandwidth is appropriate for the protection of analogue angle-modulated radio-relay systems against interfering signals. Any established power limit must be suitable for the various methods of modulation, numbers of telephone channels and earth station antenna sizes that might be used. The report discusses this in detail.</p> <p>Report 386-2</p>
IMPACT:	(Art. 7, App. 28)	Helps determine power in any 4 kHz band (see also 4/191).

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 3, Art. 5 Art. 7 Section VIII	387-2 (Rev. 76) (IM CCIR 4/166) (SG. 4,9)	<u>Protection of Terrestrial Line-of-Sight Radio-Relay Systems Against Interference Due to Emissions from Space Stations in the Fixed-Satellite Service in Shared Frequency Bands Between 1 and 23 GHz</u>

Report 387-2 presents a method of providing protection for terrestrial radio-relay systems by placing general restrictions on the emissions of space stations due to the impracticality of an approach involving the calculation of cumulative interference effects from many space stations on a relay system. The restrictions are expressed in terms of values of maximum permissible PFD in a reference bandwidth.

The revision adds a paragraph and annex on short-hop intersatellite links and the annex specifically investigates the possibility of frequency sharing with line-of-sight radio relay links in the bands below 10 GHz.

Revision of Report 387-2

IMPACT: (Article 5)	States allocation of short hop inter-satellite service in fixed service bands is technically feasible.
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REF.

DOC. NO.

TITLE

N/A

388-2
(SG 4,9)

Techniques for Calculating Interference
Noise in Terrestrial Radio-Relay Systems
and Systems in the Fixed-Satellite Service
Carrying Multi-Channel Telephony

Interference is calculated for
various systems and modulations and the
results are condensed into a table.

Report 388-2

IMPACT:

No direct impact on Radio Regulations.

REF.DOC. NO.TITLE

Art 7,
Section VII

393-2
(SG 4,9)

Intersections of Radio-Relay Antenna Beams
with Orbits Used by Space Stations in the
Fixed-Satellite Service

This Report geometrically considers the exposure of radio-relay antennae to emissions from communication satellites in various types of orbits (geostationary and non-stationary; phased or with arbitrary period). The effect of refraction and the $\pm 2^\circ$ variation of beam location from a geostationary satellite are taken into account.

Report 393-2

IMPACT: (Art. 7,
Section VII)

No impact. Report shows methods for calculating intersections of radio-relay antenna beams with space stations in the Fixed-Satellite Service.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VII	406-3 (SG 4,9)	<u>Line-of-Sight Radio-Relay Systems Sharing the Same Frequency Bands as the Space Station Receivers of Satellites in the Fixed-Satellite Service</u> <u>Maximum equivalent isotropically radiated power of line-of-sight radio-relay system transmitters</u>

Protection criteria is recommended in those frequency bands between 1 and 15 GHz shared between systems in the Fixed-Satellite Service and line-of-sight radio-relay systems involving reception at the space station and stating specific power limits for the radio-relay system.

Recommendation 406-3

IMPACT: (Art. 7,
Section VII)

Generally follows Radio Regulations.

REF.

DOC. NO.

TITLE

App. 28

448-1
(SG 4,9)

Calculation of Interference Probability
Between Earth Stations and Terrestrial
Stations

This Report describes a method for determining the interference probabilities between earth stations and specific terrestrial stations. One conclusion drawn was that the interference between an earth station and a terrestrial station is negligible when the interference power level for great circle propagation mechanism does not exceed the maximum permissible level of interference for 20% of the time.

Report 448-1

IMPACT: (App. 28)

No impact. Report intended as guide for calculating interference probability.

REF.

DOC. NO.

TITLE

N/A

449-1
(SG 4,9)

Frequency Sharing Within and Between Systems
in the Fixed-Satellite Service and Ter-
restrial Systems
Measured interference into frequency-
modulation television systems

In determining the conditions under which systems in the Fixed-Satellite Service can share the same frequency bands with each other as well as with terrestrial systems, it is necessary to relate the ratio of the interfered-with to interfering signal powers to the picture degradation. In contrast to telephony, where computations are reliable, it has not been possible to compute the interference between two frequency-modulated television signals, so it is necessary to rely on measurements. Measurements have been carried out in several countries and the results are summarized for subjective and objective measurements.

Report 449-1

IMPACT:

No direct bearing on Radio Regulations.

REFERENCEDOC. NO.TITLE

Art. 1

AA/10-11
(IM CCIR
11/194)Terminology Relating to the Use of Space
Communication Techniques for Broadcasting

This document raises to Recommendation status the terminology which now appears in Report 471-1; which is cancelled.

New Recommendation

IMPACT: (Art. 1)

If accepted, would provide additional definitions in Article 1 on reception quality and PFD's in the Broadcasting-Satellite Service and distribution of television programs in the Fixed-Satellite Service.

REFERENCEDOC. NO.TITLE

App. 4

AC/10-11
(IM CCIR
11/196)Spurious Emissions from Broadcasting-
Satellites at the Edges of the Band
11.7-12.5 GHz (12.2 GHz in Regions 2 & 3

This report is a brief summary of studies in Italy of out-of-band emissions from broadcasting-satellites. The conclusion is that such out-of-band emissions may not be negligible and that they could generate a need for high power, high selectivity filters for broadcasting satellites.

New Report

IMPACT: (App. 4)

Report gives data from which a standard could be established for out-of-band emissions from broadcast satellites.

REFERENCEDOC. NO.TITLE

Art. 7
Sections IA,
VII & VIII

AE/10-11
(IM CCIR
11/242)

Sharing of the 11.7-12.9 GHz Frequency
Band Between the Broadcasting-Satellite
and the Fixed-Satellite Service

This is essentially a synopsis of
Rand Report R-1463-NASA on orbit spectrum
sharing between Fixed-Satellite and
Broadcasting-Satellite Services with
applications to 12 GHz domestic systems
and applies primarily to Region 2, since
these two Services are not shared in
Regions 1 and 3.

New Report

IMPACT: (Article 7) Paper describes several approaches to
sharing among broadcast-satellites (BSS)
and between BCS and fixed-satellite systems.
This paper will have no impact on Article
7 until specific approaches are chosen.

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 28, App. 29, Art. 9	AF/10-11 (IM CCIR 11/258)	<u>Broadcasting-Satellite Service: Sound and Television</u> <u>Reference patterns and technology for transmitting and receiving antennae</u>

This draft new report not only takes over material formerly contained in Report 215-3, but provides new reference patterns for both satellite transmitting antennae and ground receiving antennae for both the co-polar and cross-polar planes. Section 3 of the document has a description (taken from the U. S. input document) of the present state of technology, including experimental data which justifies the reference patterns.

New Report

IMPACT: (App. 28, App. 29, Art. 9)	Provides reference antenna patterns for both satellite and ground receiving systems which could be incorporated in Appendix 28 and 29.
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<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Sections IA, VIII & IX	AG/10-11 (IM CCIR 11/256)	<u>Planning Elements Required for the Estab- lishment of a Plan of Frequency Assign- ments and Orbital Positions for the Broadcasting-Satellite Service in the 12 GHz Band</u>
<p>The content of the Report is summarized in its Introduction which reads as follows: "The first step in establishing a plan of frequency assignments and orbital positions for the Broadcasting-Satellite Service is to select various system characteristics in the light of their implications for planning. This paper considers the fullest possible list of such characteristics to serve as a basis for a plan in the band 11.7-12.5 GHz in Region 1 or in band 11.7-12.2 GHz in Regions 2 and 3."</p> <p style="text-align: center;">New Report</p>		
IMPACT:	(Article 7/ VIII)	Section 7 of this report gives suggested PFD values for broadcast satellite systems, however, these values do not take the effects on shared services into account (frequency 11.7-12.5 GHz).
	(Article 7/ IX)	Section 5 lists feasible values of station-keeping and antenna pointing accuracy.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	215-3 (Rev. 76) (IM CCIR 10/171) (IM CCIR 11/238)	<u>Systems for Broadcasting-Satellite Service: Sound and Television</u>

This Report describes the essential elements of Broadcasting-Satellite system design and their relationships. The object of the Report is to assist the system designer, frequency planner, and spacecraft and earth station engineer in their choice of system characteristics. Such choices, as is the case in the design of systems in general, are bounded by various constraints: limitations imposed by the state-of-the-art, international agreement, and most important, by considerations of system economics.

The revision adds text such as system examples and the quality and objectives of the Service.

Revision of Report 215-3

IMPACT:

General information.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7, Section VIII	627 (Rev. 76) (IM CCIR 11/245)	<u>Minimum Power Flux Density for Planning a Terrestrial Television Service in the 12 GHz Band (Band VI)</u>

A minimum power flux density for a satisfactory grade picture at the receiving antenna is worked out. The revision describes a system in Tokyo, adds notes and a Bibliography, and offers a range of PFD's depending on certain factors such as grade of picture.

Revision of Report 627

IMPACT:	(Art. 7, Section VIII)	Provides data on minimum PFD's required for terrestrial TV in 12 GHz band. Will contribute to determining permissible PFD's from broadcast satellites with whom they share.
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<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7 Sections VII & VIII	631(Rev. 76) (IM CCIR 11/232) (Rev. 1)	<u>Broadcasting-Satellite Service: Sound and Television</u> <u>Frequency-sharing between the broadcasting- satellite service and terrestrial services</u>

The principal modification to this report is in Section 5 concerning sharing in the band 11.7-12.5 GHz. Considerable additional detail is given concerning protection of terrestrial systems against interference from broadcasting-satellites, and there is a new subsection concerning protection of a broadcasting-satellite FM TV system against interference from terrestrial systems.

Revision of Report 631

IMPACT: (Article 7) Report discusses sharing between broadcast satellites and other services in several bands:

620-790 MHz: vs. terrestrial broadcasting
(PFD limits, power limits,
and separations are given)

2500-2690 MHz: vs. LOS, Tropo., ITFS (PFD
limits are given)

11.7-12.5 GHz: vs. Terrestrial TV and
Fixed Service (PFD limits,
power and separation
distances are given)

If adopted as a Recommendation, this paper will modify Article 7/VII, Choice of Sites and Art. 7/VIII (PFD, power limits, choice of sites).

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
N/A	632 (Rev. 76) (IM CCIR 11/195)	<u>Broadcasting-Satellite Service: Sound and Television</u> <u>Technically suitable methods of modulation</u>

The principal change from the 1974 document is to add references to the potential of digital modulation techniques for the Broadcasting-Satellite Service.

Revision of Report
632

IMPACT: None

<u>REFERENCE</u>	<u>DOC. NO.</u>	<u>TITLE</u>
Art. 7 Section IA	633 (Rev. 76) (IM CCIR 11/120) (Rev. 1)	<u>Methods for Orbit and Frequency Planning in the Broadcasting-Satellite Service</u> This is a radical revision of the 1974 Report, which had the title "The Planning of Multiple Broadcast Transmissions from Satellites". It discusses the major aspects of the two planning approaches proposed for sharing the 12 GHz band between the Broadcasting-Satellite Service and other authorized Services; the a priori planning approach of Region 1 and the evolutionary planning approach of Region 2.

Revision of Report 633

IMPACT:

No direct impact to Radio Regulations. One of basic documents from which 1977 WARC(BS) will base its approach to a plan for 12 GHz band which could establish precedent for other frequency bands.

REFERENCEDOC. NO.TITLE

App. 28,
Art. 9

634 (Rev. 76)
(IM CCIR
11/247)

Broadcasting-Satellite Service (Sound and
Television
Measured interference protection ratios
for planning sound and television
broadcasting systems

Report 634 has been redrafted to
include new material and restructured so
that the original report is now an Annex
to the summarization of both old and new
material.

Revision of
Report 634

IMPACT:

No direct impact to Radio Regulations.
Can be used in sharing studies and
development of PFD's.

<u>REF.</u>	<u>DOC. NO.</u>	<u>TITLE</u>
App. 4	329-2 (S.G. 1)	<u>Spurious Radiation (of a Radio Emission)</u>

Definitions of the terms spurious radiation, harmonic radiation, parasitic radiation, and unwanted intermodulation products are recommended for specific use. Values for limits on the power of spurious radiations for the frequencies 10 kHz through 960 MHz are recommended as well as methods of measuring spurious emissions.

Recommendation

IMPACT: (App. 4)	The table of spurious emissions only goes up to 235 MHz. This recommendation would continue it up to 960 MHz.
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APPENDIX C

RELATED DOCUMENTATION WITH NO DIRECT BEARING ON RADIO REGULATIONS

DOC. NO.
(IM CCIR)

TITLE

2/85	Antennae for Space Research Systems; Study Programme
2/87	Earth Exploration Satellites for Location of Earth Stations and for Data Collection; Revision of Report 538
2/89	Efficient Use of VariousOrbits for Space Research; New Study Programme (relates to Question 1/2; 2/2)
2/90	Radcommunication Systems for Earth Exploration Satellites; Revision of Study Programme 12A/2
2/93	Use of Satellite Systems for Disaster Warning and Relief Operations; New Question
2/95	Preferred Frequency Bands for Deep Space Research Manned and Unmanned Spacecraft; New Study Programme
2/96	Preferred Frequency Bands for Near-Earth Manned and Unmanned Spacecraft; New Study Programme
2/97	Preferred Frequency Bands for Space Research; New Question
2/99	Protection of Telecommunications Equipment from Radio-Frequency Radiation from Space Research Earth Stations; New Study Programme
2/101	Characteristics and Effects of Radio Techniques for Transmission of Energy; New Question
2/102	Preferred Frequency Bands for Use in Maintenance Telemetry, Tracking and Telecommand of Developmental and Operational Satellites; Revision of Recommendation 363-1 (cancelled)
2/107	Space Research Radio Links Between Earth Stations and Spacecraft by Means of Space Stations; Revision of Question 11/2
2/114	Ionospheric Limitations to Ground-Based Radio Astronomy Below 20 MHz; New Report
2/117	Radio Communications for Earth Exploration Satellites Data Collection and Position Location Systems; Study Programme 12D/2

DOC. NO.
(IM CCIR)

TITLE

2/118	Radio Communication Systems of Meteorological-Satellite Service; Study Programme 12B/2
2/119	Radio Communication Systems for Earth Exploration, Including Meteorological Satellites; Revision of Question 12-1/2
2/120	Sensors Used by Earth Exploration and Meteorological Satellites; New Study Programme 12C/2
2/127	The Feasibility of Frequency Sharing Between Space Research Satellites and Terrestrial Systems; New Study Programme
2/128	Sharing of Radio Frequency Bands by Links Between Space Research Earth Stations and Space Research Spacecraft and Between Other Space Services; Revision of Question 1/2
2/131	Emission Measurements of the ATS-6 Satellite in the 2690.2 - 2700 MHz Radio Astronomy Band, New Report
2/132	Preferred Frequency Bands for Spacecraft Transmitters Used as Beacons; Revision of Question 10/2
2/134	Protection Criteria for Space Research Telecommunication Links; New Study Programme
2/135	Feasibility of Frequency Sharing Between Deep Space Research Stations and Stations of Other Services; New Study Programme
2/139	Feasibility of Frequency Sharing Within and Among Space Research Systems; Revision of Question 14-1/2
2/141	Frequency Sharing Between Deep Space and Other Space Research Systems (Question 1/2); Revision of Study Programme 1B/2
2/152	Effects of Plasmas on Communications with Spacecraft; Revision of Report 222-3 (relates to Question 3/2)

DOC. NO.
(IM CCIR)

TITLE

6/165	Ionospheric Factors Influencing Communication and Navigation Systems Involving Spacecraft; Revision of Question 18-1/6
6/164	Radio Noise; New Decision
8/119	Use of Echo Suppressors and Voice Activated Carrier Switching in Maritime Mobile-Satellite Systems; New Report
8/126	Technical Characteristics of Systems Providing Communication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships; Maritime tests in band 9 (UHF); Revision of Report 598
8/134	Overall Transmission Characteristics of Telephone Circuits in the Maritime Mobile-Satellite Service; New Report
8/162	Use of Satellites for Maritime Radiocommunicaton; The effect of multipath on digital transmission; New Report
8/164	Some Factors Affecting Planning and Designing a Satellite System to be Used in the Maritime-Mobile Satellite Service; Revision of Report 592
8/170	Efficient Utilization of the Allocated Frequency Bands for the Maritime Mobile-Satellite Service; New Report
8/171	Use of Satellites for Maritime Radiocommunication Comparison of Different Modulations for Telephony; Results of test performed with ATS-6; New Report

DOC. NO.
(IM CCIR)

TITLE

8/174	Technical Characteristics of Systems Providing Communication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships; Revision of Report 594
8/175	Method of Intelligibility Evaluation of Satellite Relay Voice Transmission System; Annex to Report 599
8/182	Systems Providing Radiocommunication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships; Multiple access and communication-channel assignment in the maritime mobile-satellite service; Revision of Report 596
8/183	Use of Satellites for Maritime Radiocommunications Signal Level Variation Due to Multipath Effect; New Report
8/187	Technical Characteristics of Systems Providing Communication and/or Radiodetermination using Satellite Techniques for Aircraft and/or Ships; Aeronautical tests in band 9 (UHF); Revision of Report 599
8/191	Technical Characteristics of Systems Providing Communication and/or Radiodetermination using Satellite Techniques for Aircraft and/or Ships; Consideration of possible technical characteristics for a maritime satellite system for public correspondence; Revision of Report 601
8/195	Technical Characteristics of Systems Providing Communication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships; Multipath effects in aircraft-to-satellite communication and radiodetermination links; Revision of Report 505
8/196	Technical Characteristics of Communication Satellite Services to Aircraft and Ships; Satellite orbits for systems providing communication and radiodetermination for stations in the mobile service; Revision of Report 506

DOC. NO.
(IM CCIR)

TITLE

11/211

Characteristics of Ground Receiving Equipment
for Broadcasting-Satellite Systems; Draft Revision
of Report 473-1

AH/10-11
(IM CCIR
11/226)

Computer Programs for Use in Planning Satellite
Services; New Report

11/238

Systems for Broadcasting-Satellite Service: Sound
and Television; Revision of Report 215-3

AD/10-11
(IM CCIR
11/241)

Broadcasting-Satellite Service; Space segment
technology; New Report

APPENDIX D

**SPACE COORDINATION CORRESPONDENCE
ON SHARING AND RELATED STUDIES**

September 13, 1976


Mr. Harry A. Feigleson
Cdr. Naval Telecommunications Command
Naval Telecommunications Headquarters
4401 Massachusetts Avenue, N. W.
Washington, D. C. 20390

Attention: SAFM

Dear Mr. Feigleson:

As Space Coordinator for Ad Hoc 144-III I have noted that a number of sharing and related studies have been suggested in Ad Hoc 144-Id to provide technical support for allocation proposals in bands where a space service is sharing with other space and/or terrestrial services. The attached list indicates those that were identified with your Agency.

It is, of course, up to each agency to determine the extent to which it provides technical information supporting its proposals, including the submission of papers to the CCIR. In regard to this latter point, I would appreciate being kept informed of your plans for CCIR papers and the Study Group to which you will submit them. I would also like to receive copies of the reports when they are written. This is so that we can keep the information on the state of technical preparation on space related matters for the 1979 GWARC complete and up-to-date.



E. L. Eaton
Space Coordinator
Ad Hoc 144-III

NAVY

BAND (GHz)

SHARING SERVICES

20*, 36***

Fixed-Satellite, Mobile-Satellite

40**, 151-170*

Fixed, Mobile, Fixed-Satellite,
Mobile-Satellite

70**

Fixed-Satellite, Mobile-Satellite,
Radiolocation

*With Army and Air Force

**With Army

***With Air Force

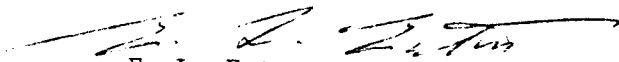
September 13, 1976

Mr. Alan W. Anderson
Army Frequency Management (DAMO-TCF)
Director of Telecommunications & Command
& Control
Office of Deputy Chief of Staff for
Operations and Plans
Department of Army, Pentagon
Room BF76B
Washington, D. C. 20310

Dear Mr. Anderson:

As Space Coordinator for Ad Hoc 144-III I have noted that a number of sharing and related studies have been suggested in Ad Hoc 144-Id to provide technical support for allocation proposals in bands where a space service is sharing with other space and/or terrestrial services. The attached list indicates those that were identified with your Agency.

It is, of course, up to each agency to determine the extent to which it provides technical information supporting its proposals, including the submission of papers to the CCIR. In regard to this latter point, I would appreciate being kept informed of your plans for CCIR papers and the Study Group to which you will submit them. I would also like to receive copies of the reports when they are written. This is so that we can keep the information on the state of technical preparation on space related matters for the 1979 GVARC complete and up-to-date.



E. L. Eaton
Space Coordinator
Ad Hoc 144-III

ARMY

BANDS (GHz)

SHARING SERVICES

14

Fixed-Satellite (Earth-to-Space),
Mobile-Satellite (Earth-to-Space),
Radionavigation

14

Fixed-Satellite (Earth-to-Space),
Mobile-Satellite (Earth-to-Space),
Radionavigation-Satellite

14, 27, 50, 76-84, 92-95,
102-105, 201-225, 240-250

Fixed, Mobile, Fixed-Satellite,
Mobile Satellite

18*

Fixed-Satellite, Mobile-Satellite,
Fixed, Mobile, Earth Exploration
Satellite (Space-to-Earth)

20**, 140-142, 151-170**,
266-275

Fixed-Satellite, Mobile-Satellite

40***

Fixed-Satellite (Space-to-Earth),
Mobile-Satellite (Space-to-Earth),
Fixed, Mobile

70***

Fixed-Satellite, Mobile-Satellite,
Radiolocation

*With NASA

**With Navy and Air Force

***With Navy

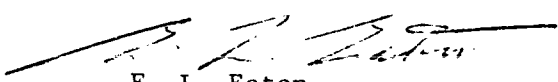
September 13, 1976

Mr. James B. McElroy
NASA Member of IRAC
NASA HQ, Code TN
600 Independence Avenue, S.W.
Washington, D. C. 20546

Dear Mr. McElroy:

As Space Coordinator for Ad Hoc 144-III I have noted that a number of sharing and related studies have been suggested in Ad Hoc 144-Id to provide technical support for allocation proposals in bands where a space service is sharing with other space and/or terrestrial services. The attached list indicates those that were identified with your Agency.

It is, of course, up to each agency to determine the extent to which it provides technical information supporting its proposals, including the submission of papers to the CCIR. In regard to this latter point, I would appreciate being kept informed of your plans for CCIR papers and the Study Group to which you will submit them. I would also like to receive copies of the reports when they are written. This is so that we can keep the information on the state of technical preparation on space related matters for the 1979 GARC complete and up-to-date.



E. L. Eaton
Space Coordinator
Ad Hoc 144-III

NASA

<u>BAND (GHz)</u>	<u>SHARING SERVICES</u>
10	Radiolocation (Secondary), EES (Passive), Space Research (Passive)
10	Fixed, Mobile, EES (Passive), Space Research (Passive)
12	Fixed, Mobile, Deep Space Research (Space-to-Earth)
13,17,35,70	Radiolocation, EES (Active Sensors), Space Research (Active Sensors)
14	Fixed, Mobile, Fixed-Satellite, Mobile-Satellite, Space Research
17	Radiolocation, Deep Space Research (Earth-to-Space)
17,19	Fixed-Satellite (Space-to-Earth), EES (Passive), Space Research (Passive)
18*	Fixed, Mobile, Fixed-Satellite, Mobile-Satellite, EES (Space-to-Earth)
31	Fixed (Secondary), Mobile (Secondary), EES (Passive), Space Research (Passive), Radio Astronomy
36	Fixed-Satellite, Mobile-Satellite, EES (Passive), Space Research (Passive)
54,116-126	Inter-Satellite, EES (Passive), Space Research (Passive)

*With Army

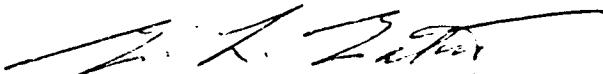
September 13, 1976

Mr. Robert H. Simmons
USAF Frequency Management Office
Washington, D. C. 20330

Dear Mr. Simmons:

As Space Coordinator for Ad Hoc 144-III I have noted that a number of sharing and related studies have been suggested in Ad Hoc 144-Id to provide technical support for allocation proposals in bands where a space service is sharing with other space and/or terrestrial services. The attached list indicates those that were identified with your Agency.

It is, of course, up to each agency to determine the extent to which it provides technical information supporting its proposals, including the submission of papers to the CCIR. In regard to this latter point, I would appreciate being kept informed of your plans for CCIR papers and the Study Group to which you will submit them. I would also like to receive copies of the reports when they are written. This is so that we can keep the information on the state of technical preparation on space related matters for the 1979 GVARC complete and up-to-date.



E. L. Eaton
Space Coordinator
Ad Hoc 144-III

AIR FORCE

<u>BAND (GHz)</u>	<u>SHARING SERVICES</u>
20*, 36**	Fixed-Satellite, Mobile-Satellite
59-64, 126-140, 170-174.5, 176.5-182, 185-190	Fixed, Mobile, Inter-Satellite
151-170*	Fixed, Mobile, Fixed-Satellite, Mobile-Satellite

*With Army and Navy
**With Navy



OCT 13 1976

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR MILITARY OPERATIONS
WASHINGTON, D.C. 20310

REPLY TO
ATTENTION OF: DAMO-TCF

1 October 1976

Mr. E. L. Eaton
Space Coordinator
Ad Hoc 144-III
National Aeronautics and Space Administration
Room 521 I, FOB 10-B
600 Independence Avenue, S.W.
Washington, D.C. 20546

Dear Mr. Eaton:

This office has reviewed the list of sharing studies suggested by the convener of Ad Hoc 144-Id. The Army will provide support for the provisions concerning transportable earth stations as encompassed by the proposals for Mobile-Satellite allocations. In view of this, six studies have been identified which will satisfy the requirements for the technical justification of proposed Article 5 changes.

The studies will address only those earth stations which are located on land and are operated while stationary. Coordination is in progress with the Navy and the Air Force concerning studies necessary to address mobile shipborne and airborne earth stations.

I will certainly keep you informed of the progress of these studies and furnish draft copies for your comments. The DoD Electromagnetic Compatibility Analysis Center (ECAC) has been tasked to prepare these studies. A list of the subjects of the reports for these studies is inclosed.

A. W. ANDERSON
Army Frequency Manager

1 Incl as

CF: Army Member, Ad Hoc 144-III

RECOMMENDED TECHNICAL REPORTS FOR ARMY SUPPORT
OF MOBILE-SATELLITE PROPOSALS

Report 1

Introduced into CCIR and Ad Hoc 144-III

Subject: Sharing Between Mobile-Satellite Service and Other Services

- (A) Sharing of Geosynchronous Orbit Resources Between Earth Stations Operating in the Fixed- and the Mobile-Satellite Services.
- (B) Power Flux Density Limitations for Frequency Sharing Between the Mobile-Satellite Service and Terrestrial Microwave Systems.

Report 2

Introduced into CCIR and Ad Hoc 144-III

Subject: Technical Development of the Expedited Coordination Procedure

Report 3

Introduced into Ad Hoc 144-Ie

Subject: Expedited Coordination Procedures (ExCoor) for the Land Mobile-Satellite Service

Report 4

Introduced into Ad Hoc 144-III

Subject: Frequency Sharing Between the Mobile-Satellite Service and the Radionavigation/Radionavigation-Satellite Services with Respect to Footnote 408A

Report 5

Introduced into CCIR and Ad Hoc 144-III

Subject: Preferred Characteristics of Mobile-Satellite Systems

- (A) Preferred Range of Frequencies and Modulation for the Mobile-Satellite Service.
- (B) Preferred Performance Characteristics of Earth Stations and Space Stations for Mobile-Satellite Systems.

Report 6

Introduced into CCIR and Ad Hoc 144-III

Subject: System Characteristics Defined for Insuring Compatibility with Other Systems and Effective Use of Allocated Frequencies